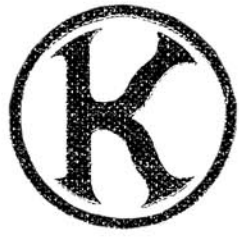
CATALOGUE

SCIENTIFIC INSTRUMENTS

GENERAL SCIENCE

PHYSICS-CHEMISTRY

BIOLOGY



L. E. KNOTT
APPARATUS COMPANY
BOSTON

PRICES

The publication of this edition of our catalogue has been delayed on account of the unsettled conditions following the war.

We now have confidence in the apparent trend towards greater stability and lower costs and we believe we shall be able to maintain the reductions made in this list. You will note a marked decrease from prices previously current.

Should costs of material and skilled labor continue to decline, new price-lists will be issued and our customers receive full benefit of any further reductions made possible by this decline.

TERMS

CORRESPONDENCE. Customers writing us should use an official letter head wherever possible indicating the institution connected with and the position held.

ORDERS. When ordering give the catalogue number and sufficient description to indicate clearly the article desired. We will furnish order blanks upon request.

SHIPPING. State clearly the place to which the goods are to be shipped, giving the city, county and State address. In the absence of specific instructions, we exercise our best judgment as to the manner and route of shipment. We charge for boxing and casing at cost.

REMITTANCES. Our terms are net thirty days. We allow a cash discount of 1% from the face of the bill if the check is mailed within ten days from the date of the invoice. Foreign remittances must be made in the form of a draft, payable at par in Boston or New York.

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REPAIRS. If goods are sent to us for repair, see that the case is properly marked, showing the name of the sender, mailing a letter at the same time stating what you are returning and the work you wish done.

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L. E. KNOTT APPARATUS COMPANY
BOSTON, MASS.

Scientific Instruments

Catalogue 26

L. E. Knott Apparatus Company

AMES AND AMHERST STREETS

(Cambridge A Station)

BOSTON

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Secretary

August 1, 1921

Form No. M 19

Circulars, Bulletins and Price Lists will be issued from time to time supplementing this catalogue.

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L. E. KNOTT APPARATUS COMPANY.

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Name.....School.....

City or Town.....State.....

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School.....City or Town.....

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26 or 26C

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Name.....	.....	.....
Name.....	.....	.....

Principal or Director of School.....

Superintendent of Schools.....

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Institution.....

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Date..... Position.....

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LABORATORY FURNITURE

Since 1896 we have maintained a special department for the critical investigation and study of laboratory and lecture room needs. It has been the duty of this department to design and manufacture both the laboratory and lecture room tables and the special and distinctive general fittings which are necessary in order to give the best possible facilities for high-grade science work.

On the following pages we list a few of our standard designs which have proved most generally useful. We endeavor to carry a stock of these designs and are, therefore, usually able to make immediate shipment upon receipt of an order.

We have the best of facilities for building furniture to order and the services of our draughtsmen and designers are freely offered to those who are planning new laboratories.

Kinds of Wood. All lumber or wood used in the construction of our cabinet work is thoroughly air-seasoned and kiln-dried. Exposed exterior wood is of solid oak, carefully selected and matched. Interior woods are maple, birch, gum wood, chestnut, etc., selected and used where best adapted. Tops are built up from narrow strips of best grade of pine, straight grained and absolutely free from knots. These strips are machined, matched, and glued in a manner to prevent warping.

Finish. All exterior woodwork, except tops, is filled and stained to a medium "Golden Oak" color, and finished with shellac rubbed to a dull non-scratchable surface. The tops are treated and carbonized to make the surface alkali and acid resistive, resulting in a dull black durable color.

WORK TABLES

Standard Designs

No. 1–100

No. 1–120

1–100 PHYSICS WORK TABLE with FOUR DRAWERS, FIXED UPRIGHTS and MOVABLE CROSS-BAR.
Cross-bar adjustable on uprights by the Knott Non-Binding Three-Part Clamp.
Length, 6 feet; width, 4 feet; height, 34 inches.

1–120 PHYSICS WORK TABLE with REMOVABLE METAL UPRIGHTS, CROSSBAR and CLAMPS.
Length, 6 feet; width, 4 feet; height, 34 inches.
This unit consists of No. **1-125** Work Table with the following rods and clamps which will be found listed in this catalogue:

2 No. 5–366 Table Clamps.
2 No. 5–20e Threaded Upright Rods, 100 cm. long, 19 mm. diam.
1 No. 5–40c Cross Bar Rod, 185 cm. long, 19 mm. diam.
2 No. 5–765 Right Angle V Clamps.

1–125 WORK TABLE. This table is illustrated over No. **1–120,** but No. **1–125** is furnished without any of the accessories listed under No. **1–120.** Frequently used in Biological Laboratories.

Any of the above tables can be equipped with a lead-lined sink, 10×12 inches by 9 inches deep, with one No. **1–802** Goose-Neck Water Faucet at each end of the sink, and with one No. **1–715** Two-Way Gas Turret at each end of the table, or the Knott Mounted Four-Way Gas Turret No. **1–750** may be used for gas supply.

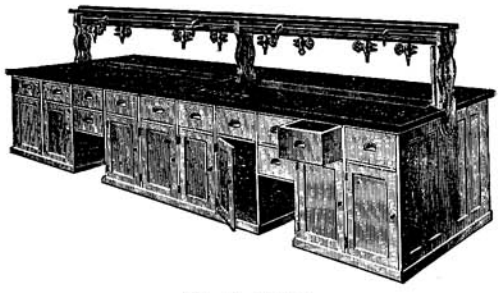
PRICES ON APPLICATION

CHEMISTRY TABLES

Standard Designs

The following designs are planned so that each pupil will have the use of one drawer and one cupboard and in common with another pupil, the use of one drawer over the waste jar space.

No. 1–225 A

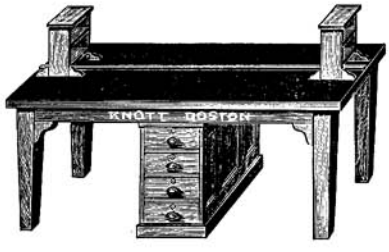


No. 1–225 C

1–225A **SIX-FOOT CHEMISTRY TABLE** to accommodate eight pupils, four working at one time.
Length 6 feet, width 3½ feet, height 34 inches.
This table is the same in design as **No. 1–225C** described below, but will accommodate but eight pupils. Four **No. 1–800** Water Faucets and four **No. 1–700** Gas Cocks are supplied.

1–225C **TWELVE-FOOT CHEMISTRY TABLE** to accommodate sixteen pupils, eight working at one time.
Length, 12 feet; width, 3½ feet; height, 34 inches.
The sink, lined with heavy sheet lead, runs through the center lengthwise of the table and drains through the end cupboard. The reagent shelf, which runs over the sink, supports the plumbing for water and gas. For water fixtures we supply eight **No. 1–800** Water Faucets; for gas, eight **No. 1–700** Gas Cocks (see page 6).

BIOLOGY TABLES



No. 1–300

1–300 **STUDENTS' COMBINATION BIOLOGY TABLE.** The table illustrated above is made up from four different units — the Biology Work Table **No. 1–300A,** a Case of Drawers **No. 1–300B,** and two Bottle Racks **No. 1–300C,** and when ordered under this number, is furnished complete as illustrated.

1–300A **STUDENTS' BIOLOGY WORK TABLE.** Length, 6 feet; width, 3 feet; height, 30 inches. A dividing strip is attached on top, lengthwise through the center. Top overhangs body 2½ inches.

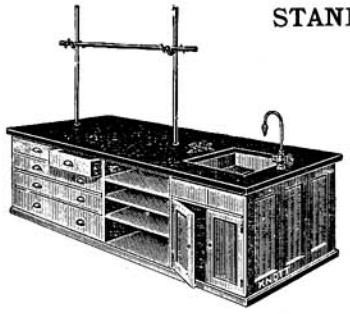
1–300B **CASE OF DRAWERS,** designed to slide under the side aprons of table **No. 1–300A,** and to extend front to back flush with the aprons. Top finished, sides paneled, and each end equipped with four drawers. Length, 31 inches; width 15 inches; height, 24 inches — overall measurements.

1–300C **BOTTLE RACKS.** Can be used on any table. Provides three shelves, the two lower 4 inches apart.

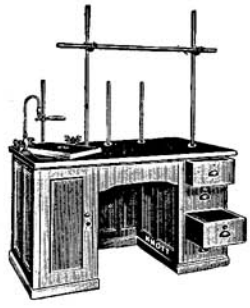
PRICES ON APPLICATION

LECTURE ROOM TABLES

STANDARD DESIGNS



No. 1–150



No. 1–200

1–150 STANDARD LECTURE TABLE. This table affords the best facilities for lecture table demonstrations in Physics, Chemistry, or General Science Courses. The front and ends are paneled; the back has three large, and two small, drawers, four open shelves and a commodious cupboard. The sink measures 18 inches square by 16 inches deep and has a shelf 8 inches wide placed 6 inches from the top. It is carefully lined throughout with sheet lead of ample thickness.
Length, 8 feet; width, 3 feet; height, 34 inches.
Equipment is furnished complete as illustrated above, as follows:

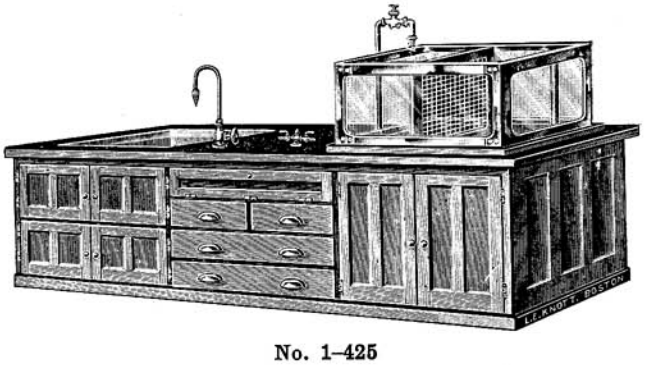
1 No. 1-802 Knott's Wheel Handle Interchangeable Nozzle Goose-Neck Water Faucet.
1 No. 1-725 Knott's Four-way Gas Turret.
2 No. 5-274 Flush Plates for 19 mm. diam. Upright Support Rods.
2 No. 5-20e Support Rods, 100 cm. long, 19 mm. diam.
1 No. 5-40b Cross Bar Rod, 125 cm. long, 19 mm. diam.
2 No. 5-765 Right Angle V Clamps.

1-200 INSTRUCTOR'S LABORATORY TABLE for small lecture rooms and various science class rooms. The front and ends are paneled; the back has one long drawer, four smaller drawers and one cupboard. The sink measures 10 inches square, by 9 inches deep, and is lined throughout with sheet lead of ample thickness. It is provided with a cover which fits flush with the top of the table.
Length, 5 feet; width, 2½ feet; height, 34 inches.
Equipment is furnished complete as illustrated above, as follows:

1 No. 1-802 Knott's Wheel Handle Interchangeable Nozzle Goose-Neck Water Faucet.
1 No. 1-715 Knott's Two-Way Gas Turret.
3 No. 5-270 Flush Plates for 10 mm. diam. Upright Support Rods.
2 No. 5-274 Flush Plates for 19 mm. diam. Upright Support Rods.
3 No. 5-10e Support Rods, 40 cm. long, 10 mm. diam.
2 No. 5-20e Support Rods, 100 cm. long, 19 mm. diam.
1 No. 5-40a Cross Bar Rod, 100 cm. long, 19 mm. diam.
2 No. 5-765 Right Angle V Clamps.

1-425 BIOLOGY LECTURE TABLE. The front and ends are paneled; the back has two large and two small drawers, a shelf cupboard with drop front, one large cupboard at the right end and one at the left end. The sink measures 22 ×20 inches by 12 inches deep and is lined throughout with pure sheet lead of ample thickness. It is provided with a removable flush cover (not illustrated) that fits flush with the top of the table.
Length, 9½ feet; width, 3 feet; height, 3 feet.
Equipment is furnished complete as illustrated, as follows:

1 Standing Overflow Plug, 10½ inches high, for the sink.
1 No. 1–802 Knott's Wheel-Handle Interchangeable Nozzle Goose-Neck Water Faucet.
1 No. 1–725 Knott's Four-way Gas Turret.
1 Special Long Goose-Neck Water Faucet for supply for tank.
1 No. 3527 Aquarium Tank complete with standing overflow plug and Wire Gauze Partition (see description, page 196.).



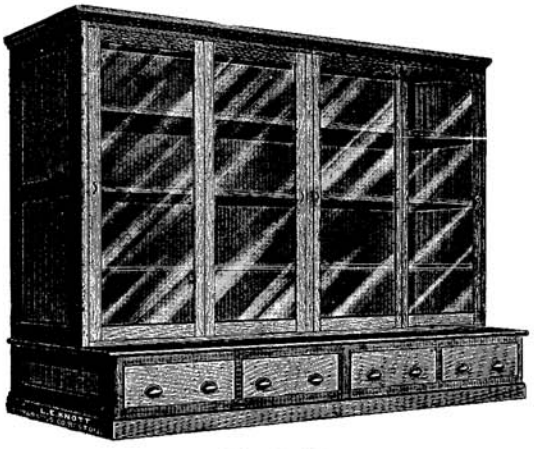
No. 1–425

PRICES ON APPLICATION

STORAGE CABINETS

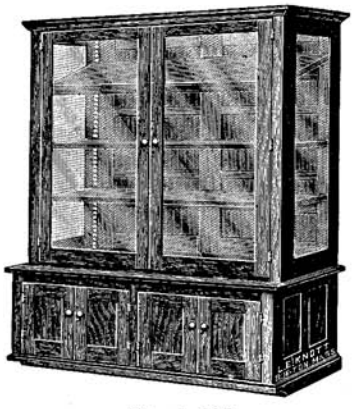
The question of adequate and serviceable storage facilities is one of prime importance in considering the equipment for any branch of science. An experience of twenty-five years has demonstrated conclusively that such equipment should be ordered to fit the space available and to meet local conditions.

Our storage cabinets are all built to order. The following designs, constructed in various desired lengths, have proved the most satisfactory of the many which we have built in the past quarter of a century.



No. 1–250

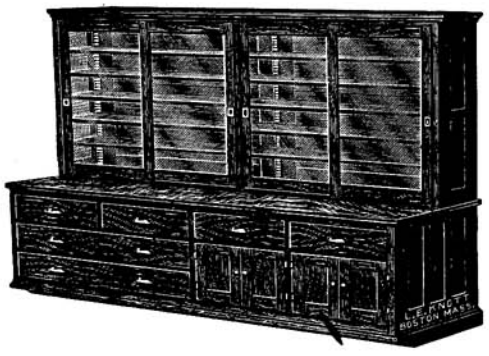
1–250 PHYSICS APPARATUS CABINET adapted also for storage of Chemical Apparatus and Chemicals. Height over all, 6½ feet; upper section, 5¼ feet, lower, 15 inches. Inside depth, upper section, 15 inches; lower section extends out to give a ledge 6 inches wide. The sliding doors with double-strength, clear-glass panels, run on ball-bearing rollers on steel tracks and are fitted as nearly dust-proof as practicable. Each door is fitted with a flush pull. Locks will be supplied only when ordered. Drawers are equal in size and extend full depth of lower section. Ends have wood panels unless otherwise ordered. The smallest unit advisable is 4 feet long. Multiples of 4 and 5 feet are recommended, but a cabinet should be ordered to fit the space available.



No. 1–605

1–605 MUSEUM CABINET, for storage and display of Biological and Botanical material. Height over all, 6½ feet; upper section, 5 feet; depth, upper section, 15 inches; lower section, 18 inches. Four paneled doors in lower section give ready access to the cupboard which extends full length of case. Ends paneled in wood. Glass-paneled doors give access to upper section. Three adjustable shelves are supplied, the top one fitted at an angle with a retaining rim on the front edge. Ends and doors have double-strength, clear-glass panels. Back is paneled in wood. Locks will be supplied only when ordered. The smallest unit advisable is four feet long. Multiples of 4 and 5 feet are recommended but a cabinet should be ordered to fit the space available.

PRICES ON APPLICATION

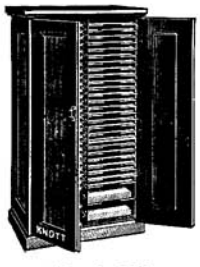


No. 1–610

1–610 COMBINATION STORAGE CABINET adapted especially for the storage and display of chemical and biological apparatus and materials, chemicals and reagents.
Height over all, 7½ feet; upper section, 4½ feet. Depth, upper section, 12 inches; lower, 24 inches.
The illustration shows two unit designs — **No. 1–611,** the Cupboard Section, and **No. 1–612,** the Drawer Section, combined and constructed as one unit. The ends are paneled in wood. The upper section has five adjustable shelves accessible by means of glass-paneled, sliding doors. Panels are of double-strength, clear glass and the doors run on ball-bearing rollers on steel tracks, and are fitted as nearly dust-proof as practicable. The lower section has two large and four smaller drawers and two commodious cupboards. Cabinets as ordinarily ordered are 8 and 10 feet long. When other lengths are desired, combinations of Cupboard Sections **No. 1–611** and Drawer Sections **No. 1–612** are recommended in multiples of four and five feet, but a cabinet should be ordered to fit the space available.

1–611 CUPBOARD SECTION. This is the right section of Combination Cabinet **No. 1–610** illustrated above. The smallest unit advisable is 4 feet long. Multiples of four and five feet are recommended, but a cabinet should be ordered to fit the space available.

1–612 DRAWER SECTION. This is the left section of Combination Cabinet **No. 1–610** illustrated above. The smallest unit advisable is 4 feet long. Multiples of four and five feet are recommended but a cabinet should be ordered to fit the space available.



No. 1–650

1–650 LOOSE-LEAF FILING CABINET for general use as a loose-leaf filing cabinet and for the storage of students' laboratory notebooks.
Height, 40 inches; width, 22½ inches; depth, 14 inches.
There are fifty-two compartments, each of which measures 11×8⅞ inches by 1 inch deep, and accommodates 200-250 separate sheets of paper. Each of the four large compartments measures 11×8⅞ inches by 3 inches deep, and accommodates about 1000 separate sheets of paper. All compartments are legibly numbered. Ends and doors are paneled.

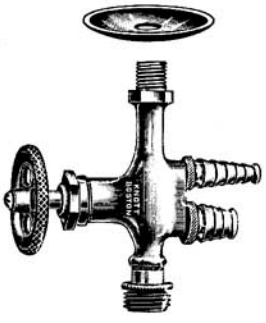
PRICES ON APPLICATION

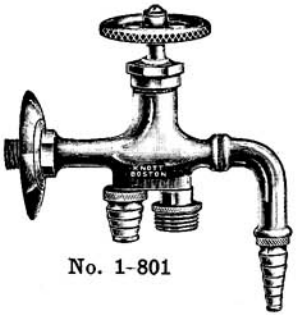
FUME CLOSETS

Fume Closet designs require a careful consideration of the individual requirements. We have designed and built many fume closets during our long experience and should be pleased to offer suggestions to meet your requirements. Multiples of two, four, and six feet are recommended. An individual compartment of two feet is the smallest compartment advisable.

PRICES ON APPLICATION

KNOTT'S SCIENCE LABORATORY FITTINGS


No. 1–800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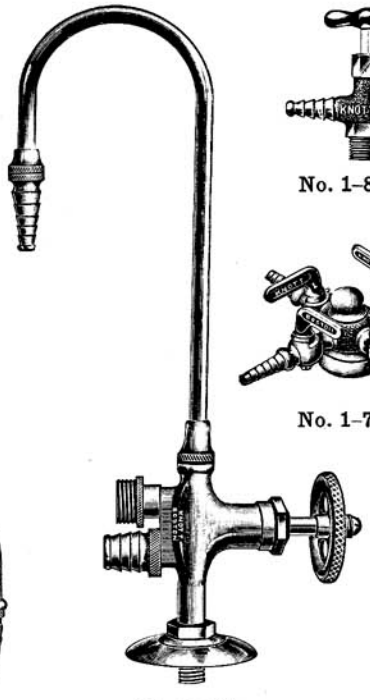
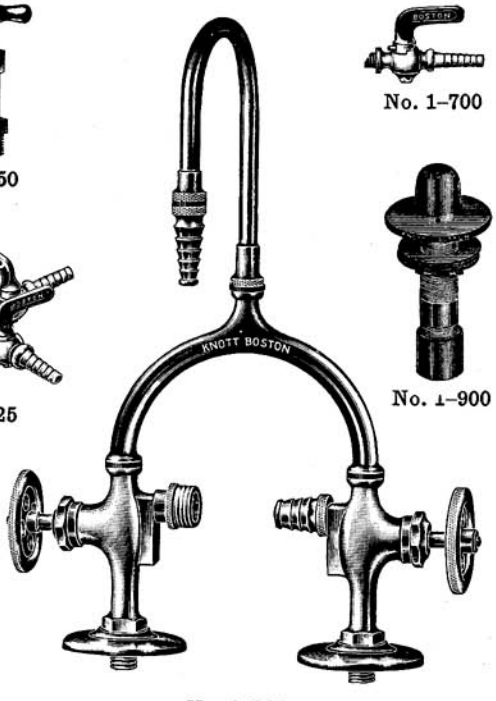

No. 1–802

No. 1–850

No. 1–725


No. 1–805

No. 1–700

No. 1–900

KNOTT'S GAS COCKS

The Knott's Gas Cocks are of heavy brass. The nipples are long and have five sharp serrations which make it easy to slip on rubber tubing, but impossible to pull it off accidentally. Adjustment is secured by means of a lever handle.

1–700 KNOTT'S LEVER HANDLE GAS COCK, ⅛-inch I. P. **$0.85**

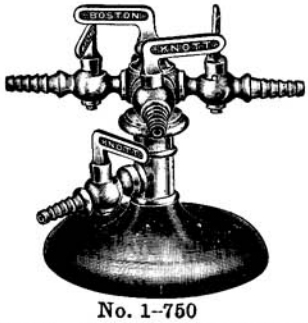
1–705 KNOTT'S BOSTON SCHOOLHOUSE COMMISSION LEVER HANDLE GAS COCK, same as above, but with tension and check nut to regulate the tension on the valve seat ..... **.95**

1–710 KNOTT'S ONE-WAY GAS TURRET, one gas cock **2.15**

1–715 KNOTT'S TWO-WAY GAS TURRET, two gas cocks **2.95**

1–720 KNOTT'S THREE-WAY GAS TURRET, three gas cocks **3.75**

1–725 KNOTT'S FOUR-WAY GAS TURRET, four gas cocks **4.55**


No. 1–750

1–750 KNOTT'S MOUNTED FOUR-WAY GAS TURRET or MOVABLE FOUR-WAY GAS DISTRIBUTOR. The use of this design obviates all necessity of cutting a table top. It is connected by rubber tubing to a supply cock left at the floor line or above the table. **10.90**

KNOTT'S WATER FAUCETS

These faucets are of heavy brass with full nickel finish. Three interchangeable attachments are provided — two for connecting rubber tubing from ¼ to ¾ inch in diameter, the third a regular hose bib coupling for attaching an aspirator. Adjustment is secured by a large wheel handle, which experience has proved to be the most practical for student use.

1–800 KNOTT'S WHEEL HANDLE INTERCHANGEABLE NOZZLE STRAIGHT WATER FAUCET, ⅜ inch I. P. **$6.25**

1–801 ——, BENT WATER FAUCET, ⅜-inch I. P. with N. P. flange ... **7.85**

1–802 ——, GOOSE-NECK WATER FAUCET, ⅜-inch I. P. with N. P. flange **8.75**

1–805 KNOTT'S COMBINATION GOOSE-NECK HOT AND COLD WATER FAUCET, ⅜-inch I. P. with two N. P. flanges **16.25**

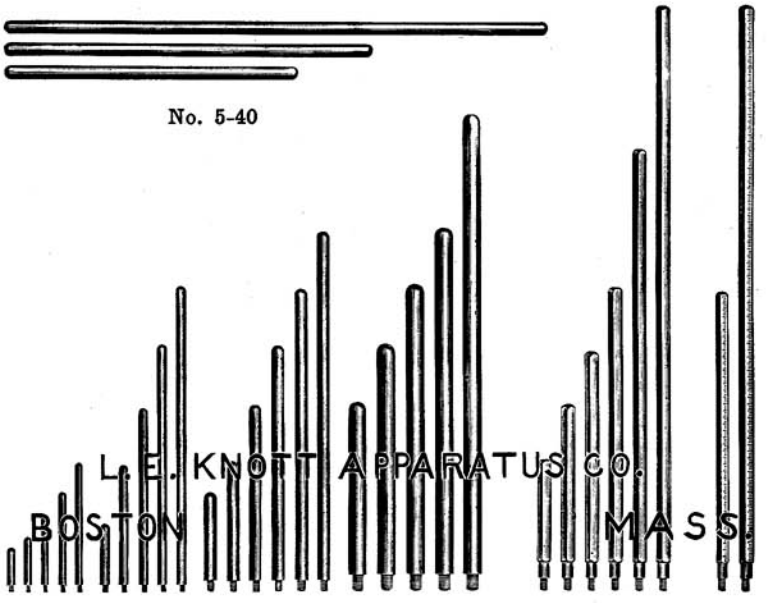
1–850 KNOTT'S COMPRESSED AIR COCK, ¼-inch I. P. An exceptionally well-made air cock, particularly adapted to science laboratory use **2.00**

1–860 KNOTT'S STEAM COCK, ¼-inch I. P., similar in appearance to the above **2.50**

1–900 KNOTT'S CAST IRON BEEHIVE OVERFLOW PLUG, Dartmouth Model. Insures a continuous drain from sink but at the same time the retaining of water for the dilution of corrosive liquids. A small hole at the base of the beehive permits the draining to emptiness, holes at top of beehive retain water to depth of 2 inches in the sink. Flange, 5 inches diameter by 5/16-inch thick. Tail piece requires hole 2 inches in diameter. Flange and beehive is cast in one piece. Complete with tail piece, hose coupling, washers and lock nut **4.35**

LABORATORY SUPPORT RODS

Our Rods are of cold-rolled Bessemer steel, copper-plated and heavily nickeled, thus obviating the possibility of rust deterioration. They are straight, of uniform diameter, machine-threaded, and shoulders faced to attain a perfect junction on our bases and flush plates.



Nos. 5-10 to 5-55

5-10 SUPPORT RODS, 10 mm. diameter, threaded to fit any hole tapped ¼×20.

	a	b	c	d	e
Length	10	15	20	30	40 cms.
Each	**$0.35**	**$0.45**	**$0.55**	**$0.65**	**$0.75**

5-15 SUPPORT RODS, 13 mm. diameter, threaded to fit any hole tapped ⅜×16.

	a	b	c	d	e
Length	20	40	60	80	100 cms.
Each	**$0.55**	**$0.75**	**$1.00**	**$1.20**	**$1.45**

5-20 SUPPORT RODS, 19 mm. diameter, threaded to fit any hole tapped ½×12.

	a	b	c	d	e	f
Length	30	40	60	80	100	120 cms.
Each	**$1.00**	**$1.20**	**$1.60**	**$2.00**	**$2.20**	**$2.40**

5-30 SUPPORT RODS, 30 mm. diameter, threaded to fit any hole tapped ¾×10.

	a	b	c	d	e
Length	60	80	100	120	160 cms.
Each	**$2.40**	**$2.80**	**$3.45**	**$3.90**	**$4.70**

5-40 SUPPORT RODS, for use as horizontal rods, 19 mm. diameter, ends rounded.

	a	b	c
Length	100	125	185 cms.
Each	**$2.10**	**$2.40**	**$4.00**

5-50 SQUARE SUPPORT RODS, 19 mm. square, one end turned to 19 mm. diameter, and threaded to fit any hole tapped ½×12. No. **5-50 d-f** are most frequently used as bed-rods of optical benches.

	a	b	c	d	e	f
Length	40	60	80	100	120	200 cms.
Each	**$1.90**	**$2.40**	**$2.90**	**$3.25**	**$3.80**	**$6.20**

5-55 SQUARE SUPPORT RODS, same as Nos. **5-50d** and **5-50f,** but graduated to mm. A few of these rods are valuable additions to every laboratory, as they may be used in many ways other than as bed-rods for optical benches — the purpose for which they were originally intended.

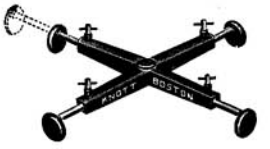
	a	b
Length	100	200 cms.
Each	**$12.00**	**$18.00**

MISCELLANEOUS BASES

Nos. 5–100 to 5–215

No. 5–240

No. 5–242



No. 5–250

TRIPOD BASES

Our line of tripod bases is scientifically designed to give the greatest possible degree of stability without occupying too much room on the working table. The nine sizes of the series fill all needs from the standpoint of size, stability, and the use of all the rods listed on the previous page. Each tripod is faced top and bottom that shoulders of support rods may make close junction and may be in true perpendicular with the plane of the base. All holes are machine-drilled and threaded.

Our castings are uniformly smooth, thus offering a good surface for a strikingly smooth and beautiful finish.

All sizes are carried in stock with and without leveling screws.

WITHOUT LEVELING SCREWS					WITH LEVELING SCREWS				
Cat. No.		Length of Leg, cm.	Tapped	Each	Cat. No.		Length of Leg, cm.	Tapped	Each
5–101	——,	6	¼×20	**$0.50**	**5–100**	——,	6	¼×20	**$1.46**
5–105	——,	8	¼×20	**.75**	**5–104**	——,	8	¼×20	**1.70**
5–111	——,	10	¼×20	**1.20**	**5–110**	——,	10	¼×20	**2.16**
5–115	——,	12	¼×20	**1.70**	**5–114**	——,	12	¼×20	**2.66**
5–125	——,	14	⅜×16	**1.80**	**5–120**	——,	14	⅜×16	**2.76**
5–135	——,	18	⅜×16	**2.35**	**5–130**	——,	18	⅜×16	**3.30**
5–145	——,	18	½×12	**2.35**	**5–140**	——,	18	½×12	**3.60**
5–155	——,	21	½×12	**2.75**	**5–150**	——,	21	½×12	**4.00**
5–165	——,	26	½×12	**3.88**	**5–160**	——,	26	½×12	**5.40**
5–175	——,	26	¾×10	**3.88**	**5–170**	——,	26	¾×10	**5.40**
5–185	——,	50	¾×10	**14.00**	**5–180**	——,	50	¾×10	**17.00**

ROUND BASES

In the design of our round bases we have followed the same rules for stability as in tripod bases listed above. Our castings are uniformly smooth, bases faced top and bottom, machine-drilled and tapped, handsomely finished.

5–200 **ROUND BASE,** diameter 8 cm., tapped ¼×20 to take any 10 mm. rod **$0.50**

5–205 ——, diameter 10 cm., tapped ¼×20 to take any 10 mm. rod . . . . . **.70**

5–210 ——, diameter 12 cm., tapped ⅜×16 to take any 13 mm. rod . . . . . **.90**

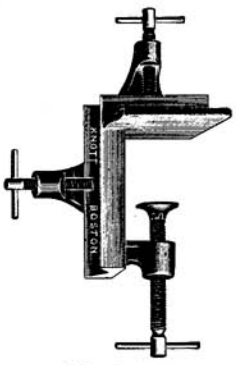
5–215 ——, diameter 15 cm., tapped ⅜×16 to take any 13 mm. rod **1.25**

5–240 **"INSTITUTE" H-BASE,** curvature of legs somewhat greater than 4×5-inch battery jar which can be placed within one inch of a support rod. Threaded ¼×20 for a 10-mm. diameter rod **1.25**

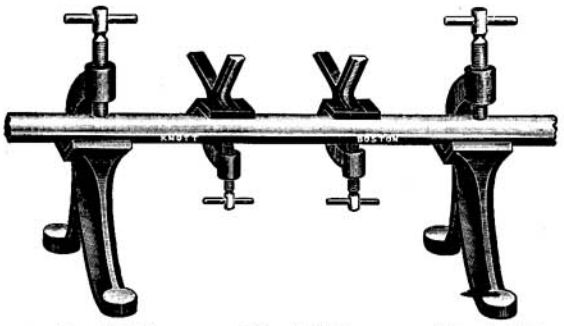
5–242 **"HARCOURT" SPECIAL H-BASE,** drilled to hold a 19-mm. diameter rod which can be clamped by the set screw. Curvature of legs somewhat greater than a 6×8-inch battery jar **2.25**

5–250 **THE KNOTT ADJUSTABLE ECCENTRIC LEVELING BASE,** telescoping extension legs adjustable to meet the stability of any round base from 11¼ to 18¼ inches in diameter. Hole drilled for 19-mm. diameter rod which may be clamped by a set screw. Eccentric discs on ends of telescoping legs give rapid and positive leveling adjustment **5.00**

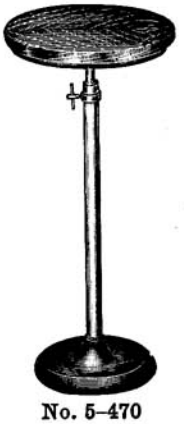
5–252 ——, **large,** legs telescoping to meet the stability of any round base from 18½ to 32 inches in diameter. **7.50**



No. 5-350

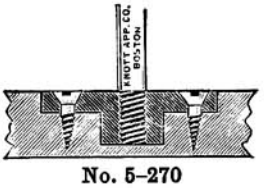


No. 5-375 No. 5-385 No. 5-375



No. 5-470

No. 5-450

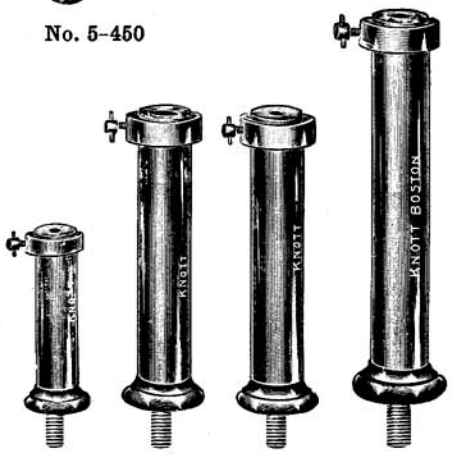


No. 5-270

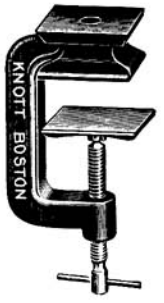
No. 5-440

No. 5-435

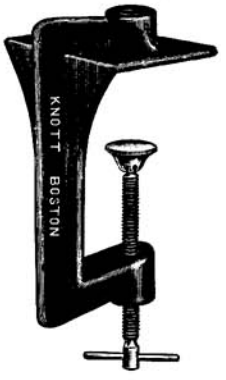
No. 5-430



Nos. 5-400 to 5-415



No. 5-360



No. 5-365

5-260 **ANDREW'S PLATE BASE,** a massive iron casting, 10×18 inches, with five threaded holes in line lengthwise through the center, located for most convenient use. Center hole threaded ⅜×16 for a 13-mm. diameter rod, and two holes in line on either side, threaded ½×12 for 19-mm. rods.. **$8.50**

5-270 **FLUSH PLATE,** a flush receptacle for a rod threaded ¼×20 ..... **.85**

5-272 ——, for a rod threaded ⅜×16 ..... **1.05**

5-274 ——, for a rod threaded ½×12 ..... **1.25**

5-350 **TABLE CLAMP** for holding round or square rods in either vertical or horizontal positions. For clamping on table top not over 7.5 cms. thick **3.50**

5-360 **TABLE CLAMP with LARGE SQUARE CAST METAL SWIVEL CAP.** Obviates danger of injury to table. Supports round or square rods threaded ½×12 (19-mm. rods) **3.00**

5-365 **TABLE CLAMP** for holding in vertical position rods threaded ⅜×16 (13-mm. rods) **2.50**

5-366 ——, for holding rods threaded ½×12 (19-mm. rods) **2.50**

5-375 **END SUPPORTS or OPTICAL BENCH BED ROD CLAMPS.** Two of these supports will hold a rod parallel to table, 3½ inches above the top ..... Each **1.55**

5-385 **SECONDARY V-SUPPORTS** for supporting objects in a horizontal position. Useful in building up telescope holders, level testers, etc. ..... Each **.60**

5-400 **STAND TUBE,** for use with rods, support bases, and stand tops, in building up adjustable stands. 20 cms. long, for 13-mm. rods. Threaded ⅜×16 ..... **2.00**

5-405 ——, 30 cms. long, for 13-mm. rods. Threaded ⅜×16 ..... **2.20**

5-410 ——, 30 cms. long, for 19-mm. rods. Threaded ½×12 ..... **3.60**

5-415 ——, 40 cms. long, for 19-mm. rods. Threaded ½×12 ..... **4.00**

5-430 **EXTENSION CLAMP** for holding two 19-mm. rods adjustably parallel to each other **1.50**

5-435 ——, for two 13-mm. rods **1.15**

5-440 ——, for two 10-mm. rods ..... **.85**

5-450 **V-OPENING EXTENSION CLAMP** for holding two 10, 13 or 19-mm rods adjustably parallel to each other **1.20**

5-470 **STAND TOP,** three-ply hardwood, diameter 15 cms., tapped to receive 10-mm. rods threaded ¼×20. **2.00**

5-475 ——, 15 cms. diameter, tapped to receive 13-mm. rods threaded ⅜×16 ..... **2.15**

5-480 ——, 20 cms. diameter, tapped to receive 13-mm. rods threaded ⅜×16 ..... **2.85**

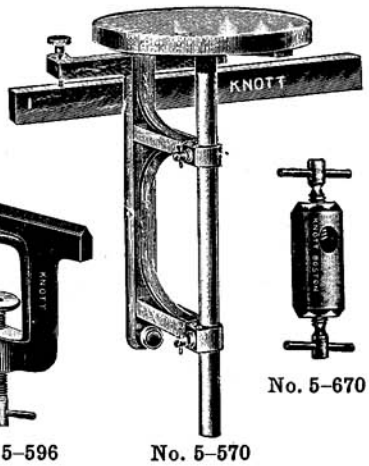
5-485 ——, 20 cms. diameter, tapped to receive 19-mm. rods threaded ½×12 ..... **3.05**

5-490 ——, 30 cms. diameter, tapped to receive 19-mm. rods threaded ½×12 ..... **3.90**

Nos. 5–635 to 5–638

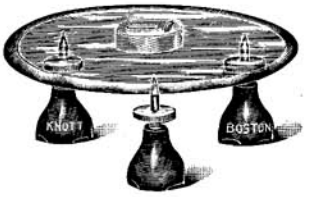
No. 5–510

No. 5–596



No. 5–570

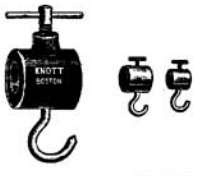
No. 5–670



No. 5–610

No. 5–525

No. 5–600



Nos. 5–645 to 5–647

No. 5–515

5–510	**ADJUSTABLE LABORATORY STAND fo table use.** Especially valuable on lecture table as an adjustable support for apparatus which requires a stable support above the top of the table. Three-ply wood top, 30 cm. diameter, height adjustable from 40 to 70 cm	$22.50
5–511	——, height adjustable from 70 to 130 cm	27.50
5–515	**GEOMETRIC STANDS** for blocking up apparatus. Top 13 inches in diameter. Top with leveling screws gives height adjustment from 2⅜ to 3 inches. Tripods vary height by 1⅛ inches. Set consists of five tripods and the top with leveling screws. Maximum height, 8½ inches. Addition of other tripods will give greater height as desired. Set	9.00
5–515a	**WOOD TOP with LEVELING SCREWS,** as used in above	5.00
5–515b	**TRIPODS** as used in **No. 5–515.** Each	.80
5–525	**CAST IRON PLATFORM,** for 10 mm. rod, top surface milled true. Measures 7×8.5 cm	1.75
5–527	——, for 19-mm. rod. Measures 7 ×8.5 cm	1.85
5–530	——, for 10-mm. rod. Measures 8.5×11.5 cm	2.10
5–535	——, for 13-mm. rod. Measures 8.5×11.5 cm	2.25
5–540	——, for 13-mm. rod. Measures 11.5×15.5 cm	2.60
5–545	——, for 19-mm. rod. Measures 14.5×21.5 cm	3.25
5–570	**ADJUSTABLE WALL STAND** for use on a rail fixed to the wall or on laboratory table, to give an adjustable, stable support for a galvanometer or other apparatus. Wood plate, 30 cm. diameter; rod, 19-mm. diameter	18.25
5–590	**KNIFE EDGE BRACKET** for permanent attachment to the wall to form a knife-edge support for practical lever experiments, etc., or with two as a support for a rod in elasticity of flexure experiments. Cast iron, japanned, knife edge milled true	1.00
5–596	**KNIFE-EDGE TABLE CLAMP,** for attaching to a table top as a knife-edge support in elasticity of flexure experiments. Cast iron, japanned, knife edge milled true	1.25
5–600	**STONE'S TENSION CLAMP** for holding either a string or wire firmly but adjustably. Originally designed for the study of composition and resolution of forces, yet of exceptional value in clamping a string or wire for any purpose. Each	.90
5–610	**LEVELING SCREWS** for use in sets of three, permitting the rapid leveling of any plane surface. Adjustable from 65 to 90 mm. in height. Per set of three	1.95
5–635	**COLLAR.** Allows a clamped collar to rotate freely, yet prevents motion along the axis. For 30-mm. rod	.80
5–636	——, for 19-mm. rod	.60
5–637	——, for 13-mm. rod	.50
5–638	——, for 10-mm. rod	.40
5–645	**COLLAR WITH HOOK,** especially useful for suspension of pendulums, pulleys, etc., on cross bar rods. For 10 mm. rod	.65
5–646	——, for 13-mm. rod	.75
5–647	——, for 19-mm. rod	.95
5–670	**RIGHT ANGLE PIECE** for holding two 10-mm. rods accurately at right angles to each other	1.00

CLAMPS

Our clamps are designed to give maximum strength at stress points with use of as little metal as practical to preserve symmetry. All our clamps are ribbed at points of stress; our castings are uniform and smooth, thus presenting a good surface for a smooth, handsome, and durable finish; all parts designed to be at right angles or parallel are as accurately so as machinists' skill can produce. As jigs and standard gauges are used as far as practicable, each lot will be found uniform in dimensions. All holes are reamed to a sliding fit; all screws are heavily nickel plated and of size proportional to size of clamp; all V's are accurately milled.

No. 5–725

No. 5–745

No. 5–760

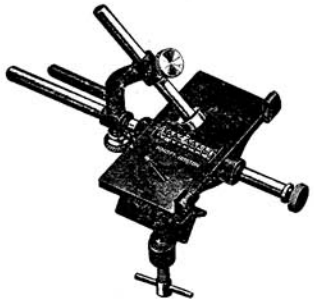
No. 5–765

No. 5–770

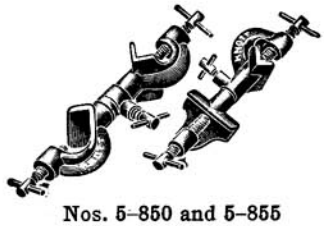
No. 5–785

No. 5–810

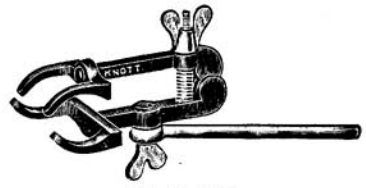
No. 5–825



No. 5–840

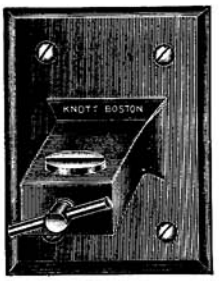


Nos. 5–850 and 5–855

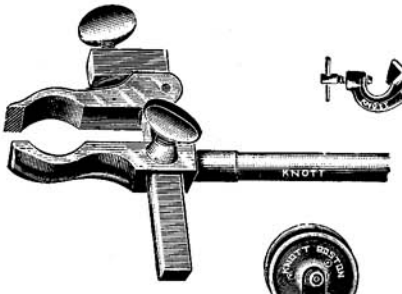


No. 5–875

5–725	**RIGHT ANGLE CLAMP,** for holding two rods in planes accurately at right angles to each other. V opening to clamp 13-mm. rod, hole for 10-mm. rod	$1.25
5–730	——, V opening for 19-mm. rod, hole for 13-mm. rod	1.45
5–735	——, for use in holding optical bench accessories. V opening for 19-mm. rod, hole for 13-mm. rod. Central (zero) point indicated	1.60
5–745	**RIGHT ANGLE CLAMP,** V opening for 30-mm. rod, hole for 19-mm. rod	1.80
5–760	**RIGHT ANGLE CLAMP,** for holding two rods in planes accurately at right angles to each other. Two V openings for 13-mm. rods	1.75
5–765	——, two V openings for 19-mm. rods	2.00
5–770	**"HARCOURT" RIGHT ANGLE CLAMP,** for holding two rods in same plane, one accurately perpendicular to the other. Two V openings for 13 to 19-mm. rods. This form of clamp will be found a marked improvement over types on the market, as more rapid changes and adjustments are possible	2.50
5–785	**RIGHT ANGLE CLAMP,** for holding two rods in same plane but accurately at right angles to each other. V opening for 19-mm. rod, tapped ¼×20 to receive 10-mm. rod	1.10
5–790	——, tapped ⅜×16 to receive 13-mm. rod	1.15
5–810	**RIGHT ANGLE CLAMP,** for holding two rods in same plane but at right angles to each other. V opening to clamp 19-mm. rod, hole for 10-mm. rod	1.85
5–815	**OPTICAL BENCH RIGHT ANGLE CLAMP,** same as above, but with central (zero) point indicated. V-opening for 19-mm. rod, hole for 10-mm. rod	2.00
5–820	——, V opening for 19-mm. rod, hole for 13-mm. rod	2.10
5–825	**RIGHT ANGLE CLAMP WITH SLIDING SPRING CONTACT,** same as **No. 5–815,** but with addition of device which holds clamp firmly to the bed-rod yet at same time permits firm sliding motion along the rod. This clamp is advised for use as support for photometer boxes as it allows of motion along rod without unlocking the set screw	2.55
5–840	**SWIVEL CLAMP, UNIVERSAL HOLDER.** This clamp is designed to meet the requirements of the lecture table. It will hold rigidly in any position such objects as telescopes, meter sticks, thermometers, burettes, glass tubing and glass rod; in fact, any instrument or piece of apparatus, either round or flat, or any object up to 50 mm. diameter, 155 mm. wide, and 30 mm. thick. It is, in fact, a universal clamp which will do the work of nearly all the clamps listed in this section	3.10
5–850	**UNIVERSAL RIGHT ANGLE CLAMP,** for holding two rods in various planes at right angles to each other. Provided with swivel for locking. Two V openings for 19-mm. rods	2.50
5–855	——, two V openings for 13-mm. rods	2.25
5–875	**UNIVERSAL CLAMP,** for objects up to 8 cm. in diameter, regular or irregular in shape. Position adjustable by swivel through 180 degrees	2.00



No. 5–910



No. 5–880

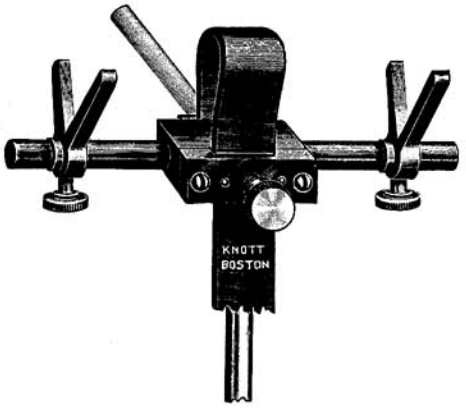
No. 5–905

No. 5–900

No. 5–950

No. 5–895

No. 5–891



No. 5–920

No. 5–952

No. 5–960

No. 5–975

No. 5–970

5–880 **CLAMP WITH PARALLEL JAWS** for holding mirrors, scales, screens, burettes, etc., or in fact any flat, round, or irregular shaped object, within the capacity of the clamp — 4 cm. opening. Rod 10 mm. diameter, 15 cm. long **$3.65**

5–891 **ROD V CLAMP** for use with one Right Angle V Clamp to secure a greater latitude of adjustment. V opening for 10 to 13 mm. rod. Rod 13 mm. diameter, 11 cm. long ..... **.80**

5–895 **METER STICK CLAMP** for holding a meter stick parallel to a support rod. V opening for 13 to 19 mm. rods **1.40**

5–900 **FOUR-PENDULUM CLAMP** for clamping to a vertical or horizontal rod to hold four pendulums. Four removable binding plates adjustable by means of knurled thumb nuts permit adjustment of lengths and afford exact points of suspension for accurate measurement of lengths **2.50**

5–902 **THREE-PENDULUM CLAMP,** similar to above, but for three pendulums **1.95**

5–905 **BI-FILAR FOUR-PENDULUM CLAMP** for clamping to a rod, to hold four pendulums in bi-filar suspension. Adjustment of lengths readily secured by turning the knurled head tapered plugs, the friction of which in the tapered holes holds the weight of the pendulum **3.95**

5–910 **WALL SUSPENSION BRACKET** for pendulum or torsion experiments. A split chuck clamps the wire firmly. Center of chuck from back face of flange, 3¼ inches **3.85**

5–920 **UNIVERSAL HOLDER WITH TWO ADJUSTABLE V'S AND LEATHER STRAP** for holding any round or square object from 7.5 to 16 cm. in length, liable to be injured by too great pressure. Will hold telescopes, burettes, etc. **7.25**

5–950 **BALL-BEARING FRICTIONLESS PULLEY MOUNTED ON ROD, axis at right angles to rod.** Polished steel ball-bearing pulley, 60 mm. in diameter, mounted in cast metal stirrup attached to nickel-plated rod, 10 mm. diameter, 15 cm. long **1.55**

5–952 **——, axis in same plane as rod**; pulley rotates at right angles to the rod **1.15**

5–960 **ADJUSTABLE 50 MM. PLANE MIRROR ON ROD.** A plane mirror, 50 mm. in diameter in metal frame, mounted in a metal stirrup attached to a nickel-plated rod, 10 mm. in diameter, 15 cm. long. Adjustable in stirrup about the horizontal axis — adjustable on the rod about the vertical axis **3.65**

5–970 **ROD ADJUSTING UNIVERSAL LENS HOLDER for lenses up to 4 inches in diameter.** The three rods can be adjusted to hold and clamp any lens up to 4 inches in diameter — the small lenses in or off center as desired. Nickel-plated rod, 10 mm. diameter, 10 cm. long **1.95**

5–975 **——, for lenses up to 2 inches in diameter** **1.65**

BASES, SUPPORT RODS, CLAMPS

No. 5-991 LECTURE LIST "A"

A carefully selected list of bases, rods, clamps, and attachments, covering the essentials and designed for schools not in position to procure a more complete outfit:

SUPPORT BASES

1	**5-200**	Round Base
1	**5-210**	Round Base
2	**5-250**	Eccentric Leveling Bases
1	**5-260**	Plate Base

SUPPORT RODS

1	**5-15b**	Support Rod, 13 mm. × 40 cm.
1	**5-15c**	Support Rod, 13 mm. × 60 cm.
1	**5-20b**	Support Rod, 19 mm. × 40 cm.
1	**5-40b**	Support Rod, 19 mm. × 125 cm.
2	**5-20e**	Support Rods, 19 mm. × 100 cm.

CLAMPS

2	**5-350**	Table Clamps
2	**5-450**	Extension Clamps
2	**5-765**	Right Angle Clamps
2	**5-770**	Right Angle Clamps
2	**5-810**	Right Angle Clamps
1	**5-850**	Swivel Clamp
1	**5-895**	Meter Stick Clamp
1	**5-900**	Pendulum Clamp

MISCELLANEOUS

1	**5-540**	Platform
4	**5-646**	Hook Collars for 13 mm. rod.
1	**5-950**	Pulley on rod
2	**5-952**	Pulleys on rod
1	**5-975**	Universal Lens Holder

5-991 LECTURE LIST "A" complete, as listed above..... Set **$62.32**

NO. 5-996 LECTURE LIST "B"

The following list has been made up by teachers of long experience and is considered and advised by them as an equipment ample for lecture table demonstrations. The selection has been made with the intention of covering every need for the lecture table, with suitable bases, support rods, clamps, and attachments which will be needed in assembling and adjusting the apparatus used in the most complete lecture table demonstration courses. Suggestions for enriching this list either by new designs or by additions of old will be greatly appreciated.

SUPPORT BASES

1	**5-101**	Tripod Base, 6 cm. for 10 mm. rod
2	**5-105**	Tripod Bases, 8 cm. for 10 mm. rod
1	**5-114**	Tripod Base, 12 cm. for 10 mm. rod
2	**5-115**	Tripod Bases, 12 cm. for 10 mm. rod
1	**5-140**	Tripod Base, 18 cm. for 19 mm. rod
1	**5-170**	Tripod Base, 26 cm. for 30 mm. rod
1	**5-242**	Special H-Base
4	**5-250**	Eccentric Leveling Bases, 11¼–18¼ inches
2	**5-252**	Eccentric Leveling Bases, 18½–32 inches
1	**5-260**	Plate Base

SUPPORT RODS

2	**5-10b**	Support Rods, 10 mm. × 15 cm.
2	**5-10c**	Support Rods, 10 mm. × 20 cm.
2	**5-10e**	Support Rods, 10 mm. × 40 cm.
2	**5-15b**	Support Rods, 13 mm. × 40 cm.
2	**5-15c**	Support Rods, 13 mm. × 60 cm.
2	**5-15e**	Support Rods, 13 mm. × 100 cm.
2	**5-20b**	Support Rods, 19 mm. × 40 cm.
2	**5-20c**	Support Rods, 19 mm. × 60 cm.
2	**5-20e**	Support Rods, 19 mm. × 100 cm.
1	**5-20f**	Support Rod, 19 mm. × 120 cm.
1	**5-30d**	Support Rod, 30 mm. × 120 cm.
1	**5-40a**	Support Rod, 19 mm. × 100 cm.
1	**5-40c**	Support Rod, 19 mm. × 185 cm.
1	**5-50d**	Support Rod, 19 mm. × 100 cm.
1	**5-50e**	Support Rod, 19 mm. × 120 cm.
1	**5-400**	Stand Tube, 20 cm. for 13 mm. rod
1	**5-405**	Stand Tube, 30 cm. for 13 mm. rod
1	**5-410**	Stand Tube, 30 cm. for 19 mm. rod
1	**5-415**	Stand Tube, 40 cm. for 19 mm. rod

CLAMPS

2	**5-360**	Table Clamps
2	**5-450**	Extension Clamps
2	**5-725**	Right Angle Clamps
2	**5-735**	Right Angle Clamps, V, 19 mm. hole 13 mm.
1	**5-745**	Right Angle Clamp, V, 30 mm. hole 19 mm.
2	**5-760**	Right Angle Clamps, 2 V's, 13 mm.
2	**5-765**	Right Angle Clamps, 2 V's, 19 mm.
4	**5-770**	Right Angle Clamps, 2 V's, 19 mm.
1	**5-785**	Right Angle Clamp, V, 19 mm., tapped ¼×20
1	**5-790**	Right Angle Clamp, V, 19 mm., tapped ⅜×16
5	**5-810**	Right Angle Clamps for optical bench
1	**5-825**	Right Angle Clamp for photometer
1	**5-840**	Universal Clamp
1	**5-850**	Swivel Clamp for 19 mm. rods
1	**5-855**	Swivel Clamp for 13 mm. rods
1	**5-875**	Universal Clamp
1	**5-880**	Clamp with Parallel Jaws
1	**5-891**	Rod V Clamp
1	**5-895**	Meter Stick Clamp
1	**5-900**	Pendulum Clamp
1	**5-905**	Bi-filar Pendulum Clamp

MISCELLANEOUS

1	**5-510**	Adj. Lab. Stand, 40–70 cm.
1	**5-511**	Adj. Lab. Stand, 70–130 cm.
1 set	**5-515**	Geometric Stands
1	**5-525**	Platform, rod 10 mm., 7× 8.5 cm.
1	**5-527**	Platform, rod 19 mm., 7× 8.5 cm.
1	**5-530**	Platform, rod 10 mm., 8.5×11.5 cm.
1	**5-535**	Platform, rod 13 mm., 8.5×11.5 cm.
1	**5-540**	Platform, rod 13 mm., 11.5×15.5 cm.
1	**5-545**	Platform, rod 19 mm., 14.5×21.5 cm.
1	**5-570**	Wall Stand
1	**5-480**	Stand Top, 20 cm. for 13 mm. rod
1	**5-485**	Stand Top, 20 cm. for 19 mm. rod
1	**5-490**	Stand Top, 30 cm. for 19 mm. rod
1 pr.	**5-375**	End Supports
1 pr.	**5-385**	Secondary Supports
1 pr.	**5-590**	Knife Edge Brackets
1 set	**5-610**	Leveling Screws
1	**5-635**	Collar for 30 mm. rod
2	**5-636**	Collars for 19 mm. rod
1	**5-637**	Collar for 13 mm. rod
1	**5-638**	Collar for 10 mm. rod
6	**5-645**	Hook Collars for 10 mm. rod
10	**5-646**	Hook Collars for 13 mm. rod
1	**5-670**	Right Angle Piece
1	**5-910**	Wall Suspension Bracket
4	**5-950**	Pulleys on rod
4	**5-952**	Pulleys on rod
1	**5-960**	Mirror on rod
1	**5-970**	Universal Lens Holder, lenses up to 4-in.
1	**5-975**	Universal Lens Holder, lenses up to 2-in.

5-996 LECTURE LIST "B" complete, as listed above. ..... Set **$296.87**

NATIONAL LOOSE-LEAF LABORATORY DIRECTION SHEETS FOR STUDENTS' USE

A series of loose-leaf direction sheets, printed on bond paper, 8½×10½ inches, punched with three holes, suitable for binding in the Harcourt Binders. A complete index of the sheets available will be sent upon request. From this index the teacher may make such selection as will best meet the requirements of his course.

By revision and frequent additions, the authors insure that the list will meet the requirements of the best educational thought in Physics teaching.

The outstanding features of a course in Physics developed by the use of these sheets have been summarized as follows:

Intense interest aroused in the pupil.
Clearness of ideas developed.
Adaptability to local requirements.
Flexibility in meeting the teacher's individual needs.
Saving of the pupil's time.
Saving of the teacher's time.

While the purpose and method of procedure are clearly stated, the pupil is given no information which the experiment itself is intended to develop.

Price, any selection desired, each experiment **$0.02**
HARCOURT BINDERS, made from heavy stock, cloth covered and supplied with binding cord Per pair .. **.40**
PAPER FILLERS — plain, ruled, cross-section and drawing papers, punched for binding in Harcourt Binders. Price list on request.

HARCOURT PORTRAITS OF SCIENTISTS

The following lists of scientists have been represented in 8×10-inch prints, mostly in platinum, designed for wall decoration. When framed in a 16×20-inch frame, they are highly satisfactory either for the laboratory or the lecture room.

Physicists

7–100 A Newton
7–100 B Faraday
7–100 C Henry
7–100 D Tyndall
7–100 E Helmholtz
7–100 F Kelvin
7–100 G Rowland
7–100 H Galileo
7–100 I Boyle

Chemists

7–125 A Priestley
7–100 B Faraday
7–125 B Lavoisier
7–125 C Dalton
7–125 D Davy
7–125 E Bunsen
7–125 F Ostwald
7–125 G Liebig
7–125 H Wohler
7–125 I Moissan
7–125 J Remsen
7–125 K Pasteur
7–125 L Mendelejeff
7–100 I Boyle

Biologists

7–125 K Pasteur
7–150 A Huxley
7–150 B Linnaeus
7–150 C Darwin
7–150 D Cuvier
7–150 E Spencer

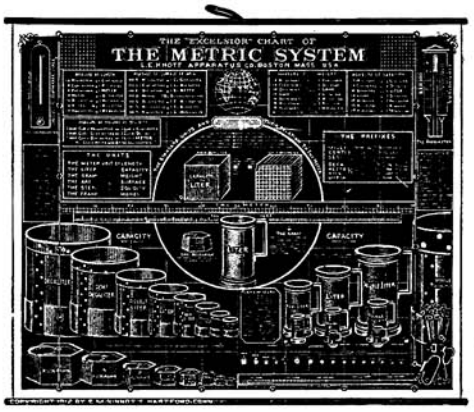
Price, Single picture **$1.25**
Selection of any six **6.75**
Selection of any twelve **12.50**

MILLER COLLECTION OF LANTERN SLIDES IN PHYSICS

Prof. Fred R. Miller of the English High School, Boston, has made a very carefully prepared selection subjects covering the entire course in Physics. A descriptive circular will be sent on request.

Price, each slide **$0.55**
Selection of 50 slides, furnished in slide box **27.50**

ILLUSTRATIVE DEMONSTRATION APPARATUS

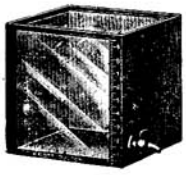


No. 10-10

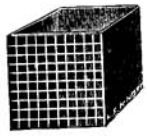
10–10 LARGE-SIZE METRIC CHART, 50 inches wide by 46 inches high, presenting graphically a comparative grouping of the Metric and English units of weights and measures. Large type, units large and lithographed in colors, and grouped in best manner for direct comparisons of the units in the two systems. Mounted on cloth back and provided with common rollers with hooks for hanging **$3.25**

No. 10-20

No. 10–25



No. 10-35



No. 10–45

10–20 GRADUATED, DISSECTED AND WEIGHTED LITER BLOCK for ocular as well as quantitative comparisons of metric units of lengths, areas, volume, capacity and weight. This block is graduated — one edge to millimeters, each face to square centimeters, all graduations showing white. It is dissectible to 1/10, 1/100 and 1/1000 of its volume; weighted so that each section has a mass equal to one equivalent volume of water **5.50**

10–25 GRADUATED LITER BLOCK, neither dissectible nor loaded **2.80**

10–30 LITER BLOCK — shows accurate size of one cubic decimeter (1000 cubic centimeters) **1.95**

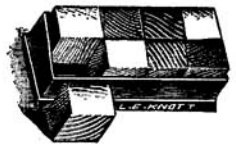
N.B. No. **10–50** Cubic Foot Block and No. **10–30** Liter Block offer a striking comparison of size of units in Metric and English systems.

10–35 BURNISHED COPPER LITER CASE, illustrating quantitatively metric equivalents in measures of capacity, volume and weight. Water-tight glass face, accurate metal scale, and brass inlet cock **7.25**

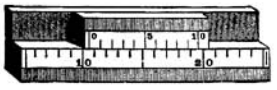
10–40 CUBIC DECIMETER (LITER) CASE, holding exactly one liter of water. Made of non-corrosive metal **2.00**

10–45 GRADUATED CUBIC DECIMETER (LITER) CASE, same as No. **10–40,** but one face graduated into square centimeters **2.50**

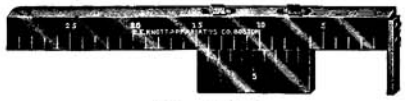
10–50 CUBIC FOOT BLOCK for illustrating size and mass of a cubic foot of wood. Built up in sections, to prevent warping and checking. Weight printed in large type on one face **13.75**



No. 10–60

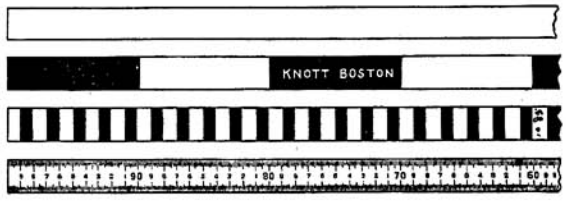


No. 10–70

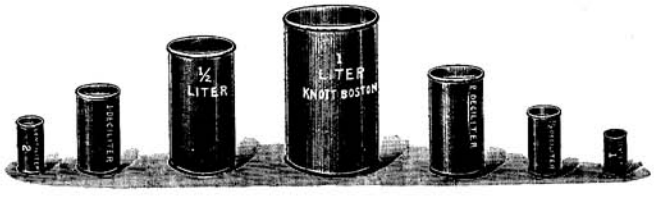


No. 10–75

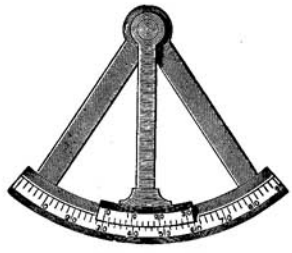
No. 10–125



No. 10–85



No. 10–100



No. 10–80

10–60 **COMPARATIVE DENSITY WOODEN CUBES** for comparative illustration of densities of wood having exactly same volume, also offering objects for simple measurements in lengths, volume and mass. Eight cubes of wood, each of different density, but each measuring exactly 4 cms. on an edge. In cardboard box **$4.50**

10–65 **CARDBOARD STRIP** (see National Loose-Leaf Direction Sheets, Exp. M011) for illustrating principle of vernier caliper by making a simple cardboard vernier caliper **05**

10–70 **LECTURE ROOM VERNIER MODEL** for demonstration and study of simple vernier. Length, 50 cms., divided into 25 spaces of 2 cms. each **3.25**

10–75 **LECTURE ROOM VERNIER CALIPER MODEL** for demonstration and study of simple vernier caliper. Length, 30 cms., with graduations to cms. Will give readings to one mm **5.25**

10–80 **LECTURE ROOM VERNIER ARC MODEL** for demonstration and study of a simple vernier arc. Vernier slides smoothly and graduations are clearly and accurately made **9.75**

10–85 **SQUARE COMPARATIVE METER STICK, divisions painted alternate black and white,** for direct comparison of metric units in one meter. Cross section, 2cms. One side graduated to millimeters; second, to centimeters; third, to decimeters — the second and third sides with divisions painted alternate black and white **3.00**

10–87 ———, not painted **1.50**

10–100 **BURNISHED COPPER LIQUID MEASURES** for comparison of metric units of capacity. **Seven measures,** 1 liter, ½ liter, 2 deciliters, 1 deciliter, ½ deciliter, 2 centiliters and 1 centiliter. Set .. **8.75**

10–105 ———, **set of three,** liter, deciliter and centiliter ..... Set **4.20**

10–110 **LIQUID MEASURES** of tin. **Eight measures,** seven as enumerated under No. 10–100, with addition of a 2-liter measure. Set of eight **7.00**

10–115 **BURNISHED COPPER LITER MEASURE** **2.20**

10–125 **WOOD DRY MEASURES, set of five,** 1, 2, 4, 8 and 16 quarts ..... Set **5.50**

MEASURES OF LENGTH

No. 11–10

11–10 **METER STICK,** maple, one side divided to ⅛ inch, other side to mm. **$0.45**

11–10A **METER STICK, SET SCREW AND SLOT** (see National Physics Direction Sheets, Exp. M151) **.60**

11–11 **METER STICK,** same as No. **11–10**, but with ends tipped with brass ..... **.52**

11–15 **HALF-METER STICK,** maple, same as No. **11–11**, but **one-half meter long** ..... **.45**

11–20 **DOUBLE METER STICK,** same as No. **11–11,** but **two meters long** **2.00**

11–40 **TEN-CM. METER STICK SECTION** ..... **.07**

11–50 **DOUBLE BEVEL BOXWOOD RULE, Metric and English scales.** One bevel graduated to mm., other to 1/16 inch; ¼ inch blank ends. ..... Each **.30**
Per dozen **3.50**

11–55 **DOUBLE BEVEL MAPLE RULE, Metric and English scales,** as in No. **11–50.** ..... Each **.12**
Per dozen **1.40**

No. 11–65

11–65 **TRIANGULAR BOXWOOD SCALE RULE, 12½ inches long,** with ten different scales, ⅛, ¼, ⅜, ½, ¾, 1, 1½, 2, 3, and 4 inches to the foot, ¼ inch blank ends ..... **.95**

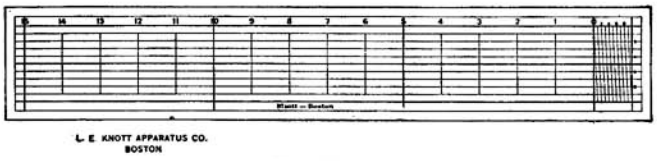
11–70 **VERTICALLY MOUNTED RULE, No. 11–40** mounted on simple base ..... **.25**

11–80 **STRAIGHT EDGE RULES,** light, clear grain, selected stock. ..... Pair **.28**

11–100 **STANDARD STEEL RULES, Metric and English scales.** Graduated on each of the four corners, reading to ½ mm., 1mm., 1/64 inch, and 1/100 inch; c to e have but 2 inches of one edge graduated to 1/64, and balance to 1/16 inch; another edge has 2 inches graduated to 1/100 and balance to 1/50 inch.

	b	bb	c	d	e
Length, cm.	10	15	20	30	50
Each	**$1.25**	**$1.75**	**$2.20**	**$2.75**	**$3.40**

11–105 **POLISHED STEEL DECIMETER RULE,** 1 mm. thick, 1 cm. wide (volume, therefore, is 1 cu. dcm.) One side graduated to mm. In metal bound case ..... **.58**



No. 11–140

11–130 **CELLULOID RULE, 6 inches long.** Graduated **Metric and English scales.**
Each, **$0.12.** Per dozen, **$1.40.** Per 100 **10.75**

11–135 **BRISTOL BOARD METRIC RULE, 20 cm. long,** graduated to mm. Per dozen, **$0.16.** Per 100 **1.00**

11–140 **BRISTOL BOARD DIAGONAL SCALE, 16 cm. long.** Will give readings to 1/10 mm.
Each, **$0.03.** Per 100 **2.75**

11–145 **BRISTOL BOARD COMPARING SCALE, 50 cm. long,** for rapid determinations of Metric and English equivalents ..... **.75**

11–160 **PAPER METRIC RULES, 20 cm. long,** heavy bond paper. Per 100 ..... **.80**

11–165 **PAPER METER SCALE, 100 cm. long,** graduated to mm., heavy bond paper. Each ..... **.12**

11–185 **FOLDING STEEL POCKET RULE IN CASE, 1 foot long,** folding to 4 inches, graduated on one side to mm., on other side to 1/16 inch ..... **.80**

11–215 **METRIC AND ENGLISH STEEL POCKET MEASURING TAPE, 1 meter long,** German silver case, spring wind with stop. Graduated on one side to mm., on other side to 1/16 inch **1.60**

11–216 **——, 5 meters long** **4.80**

11–220 **METRIC AND ENGLISH LINEN POCKET MEASURING TAPE, 10 meters long,** graduated on one side to cm., on other side to inches **1.25**

11–221 **——, 25 meters long** **2.50**

MEASURING INSTRUMENTS

Calipers, Micrometers, Verniers, Spherometers, Gauges, etc.

Nos. 12–10 to 12–11

Nos. 12–25 to 12–26

Nos. 12–27 to 12–28

12–10 **COMBINATION, OUTSIDE AND INSIDE CALIPERS,** polished steel. **Length 4 inches**..... **$.35**

12–11 ——, **6 inches long**..... **.40**

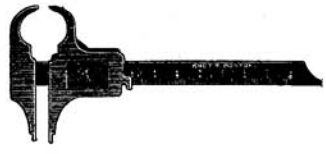
12–25 **OUTSIDE SPRING CALIPER,** extra quality polished steel machinist's caliper. **Length 4 inches.**. **.75**

12–26 ——, **6 inches long**..... **.90**

12–27 **INSIDE SPRING CALIPER,** extra quality polished steel machinist's tool. **Length 4 inches**..... **.75**

12–28 ——, **6 inches long**..... **.90**

Nos. 12–110 to 12–118



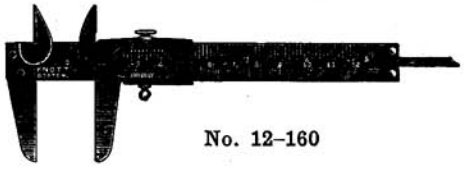
No. 12–155

12–110 **FRICTION HEAD METRIC MICROMETER CALIPER, 25 mm. by 0.01 mm.** Frame of drop-forged steel, nickel finish. The friction head insures same degree of pressure for all measurements..... **7.25**

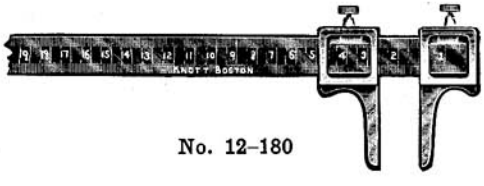
12–116 **RATCHET STOP METRIC MICROMETER CALIPER, 25 mm. by 0.01 mm.,** similar to above, but with compensated speeded screw and ratchet stop which insures same degree of pressure for all measurements..... **8.00**

12–118 **RATCHET STOP ENGLISH MICROMETER CALIPER,** same as above, but reads to 1 inch by 0.001 inch..... **8.00**

12–155 **POLISHED STEEL METRIC VERNIER CALIPER, range 0 to 10 cm.,** reads to 1/10 mm., for outside, inside and depth measurements. In use as inside caliper, read as for outside caliper and add 2 mm. for width of the points. In reading for depth measurements, use upp r row of figures and other end of vernier..... **2.65**



No. 12–160



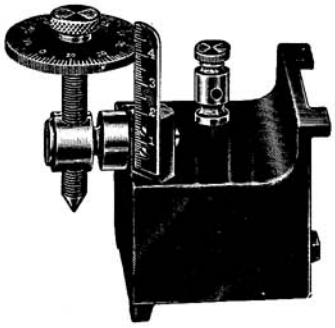
No. 12–180

12–160 **POLISHED STEEL METRIC AND ENGLISH VERNIER CALIPER, range 0 to 10.7 cm.,** reads to 1/128 inch and 1/10 mm., for outside, inside and depth measurements..... **3.85**

12–180 **METER ROD CALIPER ARMS WITH VERNIER,** Bonnell design, for use with a meter stick in assembling a vernier caliper of large range. Two verniers, one permitting readings to 1/40 inch, the other to 1/10 mm. Vernier arms only, neatly plated.....Per pair **6.50**

No. 12–205

No. 12–210



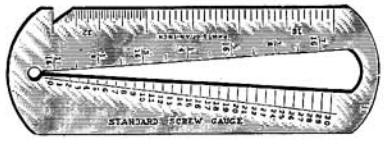
No. 12–230

12–205 **SPHEROMETER** for measuring curvature of lenses, mirrors, etc. Legs cover surface of 25 mm. radius; screw 1 mm. pitch; silvered brass head, 2 inches diameter, divided into 50 parts. Reads directly to 1/50 mm. and permits estimation to approximately 1/200 mm. **$8.75**

12–210 ——, inexpensive serviceable form, reading directly to 1/100 mm..... **6.75**

12–230 **MOUNTED MICROMETER SCREW,** massive stand, with milled legs which permit of either vertical or horizontal position of screw. Reads to 1/100 mm. Binding post for electrical connection **6.50**

No. 12–275



No. 12–280

12–275 **AMERICAN STANDARD WIRE GAUGE. Sizes 0-36** with decimal equivalents expressed in thousandths..... **3.75**

12–277 ——, **sizes 5–36**..... **3.25**

12–280 **POCKET SCREW AND WIRE GAUGE** for measuring the diameters of wires or sizes of screws. Will give sizes of screws from 0 to 36, or diameters of wires from 17 to 0000 English Wire Gauge, or from 15 to 0000 American Wire Gauge Standard. Edge graduated to 1/16 and 1/32 inch with angle cut as positive stop for head of screw in measuring length. A most practical and serviceable tool for the laboratory..... **3.75**

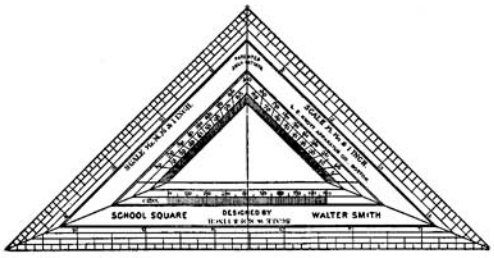
No. 12–295

No. 12–300

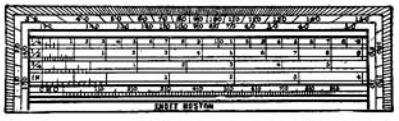
12–295 **POLISHED STEEL INSIDE TAPER GAUGE** for inside measurements of tubes, holes, etc. 18 cms. long, measures 1/10 to 15 mm..... **1.25**

12–300 **POLISHED STEEL OUTSIDE TAPER GAUGE** for outside measurements of tubes, rods, etc. 15 cms. long, measures 1/10 to 10 mm..... **3.00**

SQUARES PROTRACTORS SLIDE RULES

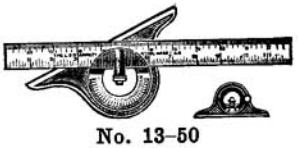


No. 13–10



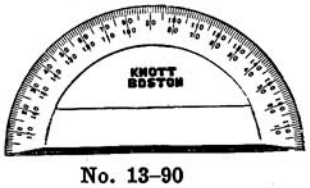
No. 13–35

13–10a **WALTER SMITH SCHOOL SQUARE,** For 35 years a standard laboratory instrument of unquestioned utility in varied applications as rule, square and protractor; 7-inch $0.10
13–10b ——, 8-inch ..... .12
13–10c ——, 10-inch ..... .18
13–35 **SQUARE PROTRACTOR,** boxwood, 6×1¾ inches, graduated to single degrees. Scales of ¼, ½, ¾ and 1-inch to the foot, scale of chords, and diagonal scale ..... .35

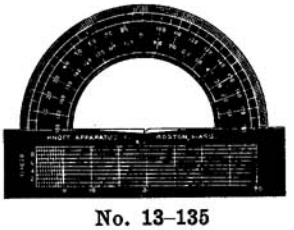


No. 13–50

13–50 **COMBINATION BEVELED PROTRACTOR, RULE AND SQUARE,** 12-inch steel rule passes through a slide in revolving turret. May be clamped at any point. A small spirit level attached to one side of this head is adjustable to show any degree 6.90

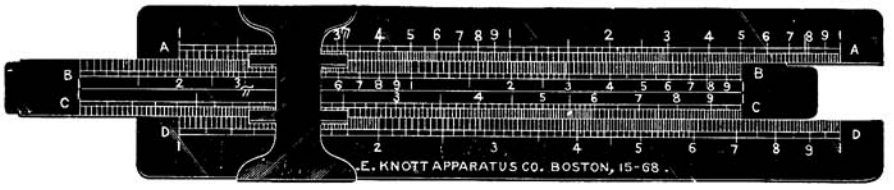


No. 13–90



No. 13–135

13–90 **PROTRACTOR, polished brass, 3¾-inch,** graduated in single degrees ..... .25
13–92 ——, engine divided, **4¼-inch,** graduated in single degrees ..... .55
13–94 ——, engine divided, **5⅛-inch,** graduated in half degrees ..... .85
13–96 ——, **German silver,** best quality, **4¼-inch,** graduated in single degrees ..... .85
13–98 ——, **5⅛-inch,** graduated in half degrees 1.20
13–100a ——, **Transparent Ambro,** graduations and figures stamped from engine-divided plate and filled in black. Diameter, **4 inches,** graduated in single degrees ..... .50
13–100b ——, **5-inch,** graduated in half degrees ..... .65
13–100c ——, **6-inch,** graduated in half degrees 1.10
13–100d ——, **8-inch,** graduated in half degrees 1.80
13–105 ——, **Bristol Board,** diameter **4 inches,** graduated in single degrees, figures reading from each end. Printed from engine-divided plate ..... Per dozen .65
13–107 ——, **5-inch,** graduated in half degrees ..... Each .24
13–135 **COMBINATION PROTRACTOR AND DIAGONAL SCALE,** brass, silver-finished, **5⅛ inches long,** graduations in single degrees, figures reading both directions. Diagonal scale reading 8 cms. by 1/10 mm 1.00



No. 13–175

13–175 **STUDENT'S SLIDE RULE, 5 inches long,** for performing arithmetical computations mechanically — multiplication, division, squares, and square roots, ratio, etc. All are possible with accuracy to three figures. This rule is made of the best quality of hard, gloss-finish bristol board, is 5 inches long, with letters, figures and graduations neatly and distinctly shown..... **$0.85**

13–180 **MANNHEIM'S SLIDE RULE, 10 inches long,** graduations on white paper with protective coating, transparent indicator in metal frame. With simple directions..... **2.00**

CIRCULAR PROTRACTORS, LEVELS, PLUMBS

14–10 **WETMORE'S TANGENT SCALE.** This design was suggested by the late Prof. E. W. Wetmore, Normal College, Albany, N. Y. It consists of an engine-divided bristol board dial 3¾ inches in diameter, divided from 0 to 90 degrees in each quadrant to single degrees. On an outer circle tangents of corresponding angles are indicated. With this dial the tangents of deflection may be noted directly instead of angles themselves, thus current strength may be compared directly without reference to any table.....Each **.12**

14–15 **CIRCULAR PROTRACTOR, bristol board, diameter 13 inches,** radial lines every 10 degrees, two outer circles graduated to single and quarter degrees.....Each **.70**

14–20 **——, bristol board, diameter 4 inches,** graduated to single degrees.....Each **.08**

14–25 **——, diameter 3 inches,** graduated to two degrees.....Each **.06**

14–45 **QUARTER-CIRCLE PROTRACTOR, bristol board,** a quadrant of circle 13 inches in diameter, radial lines every 10 degrees, graduated to single and half degrees, figures from 0 to 90 degrees in both directions. Each..... **.15**

No. 14–95

No. 14–100

No. 14–110

No. 14–130

No. 14–125

14–95 **WOOD POCKET LEVEL, 5 inches long,** fine quality, brass top..... **.50**

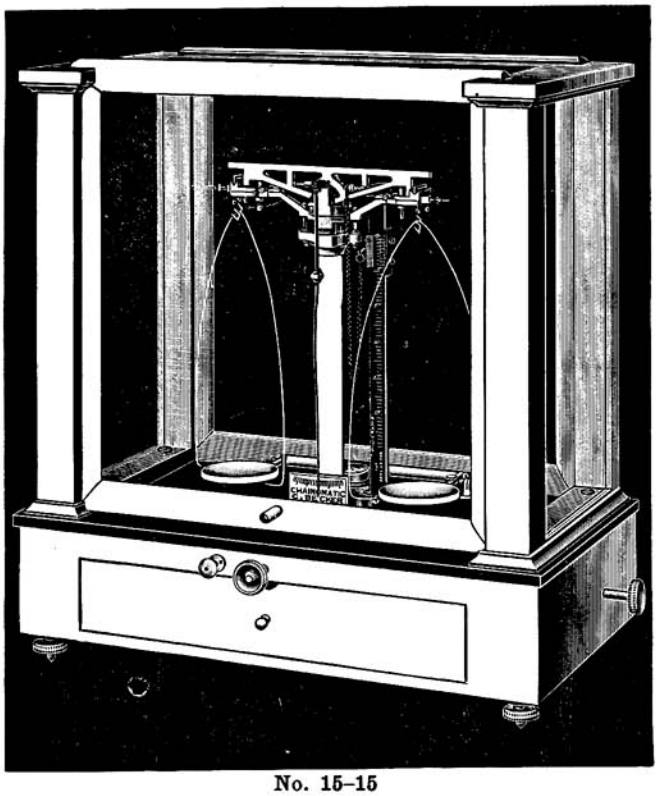
14–100 **SOLID ROSEWOOD LEVEL, 6½ inches long,** exceptional quality, brass corners, top plate, end and side views..... **2.00**

14–110 **BALANCE LEVEL,** a most useful laboratory tool, as it will indicate in all directions. Polished metal case..... **1.60**

14–125 **MERCURY PLUMB BOB, length 5 inches,** weight 6 ounces. A solid piece of steel drilled and filled with mercury. Cap provides slot for attaching line without tying, and acts as spool for winding up and fastening line when bob is not in use..... **2.25**

14–130 **IRON PLUMB BOB,** japan finish..... **.25**

15-15 CHAINOMATIC ANALYTICAL BALANCE WITH VERNIER.



No. 15-15

Capacity, 200 grams.

Sensitiveness, 1/10 mg.

Diameter of Pans, 2⅜ inches.

Width of Pan Support, 4⅛ inches.

Aluminum Beam, 6 inches long.

Independent Pan Arrest with **Automatic Stop.**

Bearings and Knife Edges of agate.

Mounting, polished mahogany case, front sliding frame counterpoised. Mounted on plate glass on drawer base.

In this balance all weighings closer than 50 mgs. are made by a rolled gold chain one end of which is hung from an arm of the scale beam, the other from a slide block which is movable up and down on a vertical graduated scale. As the slide block is moved down, more and more of the effective weight of the chain is transferred from the block to the beam. Readings to mgs. are secured directly from the graduated scale. The reading of the vernier gives weight to 1/10 mg.

PRICE, $210.00

15-16 CHAINOMATIC BALANCE WEIGHTS, 50 mgs. to 50 grams, highest degree of accuracy. Gram weights of polished brass, fractional weights of platinum. In velvet-lined, hinged-cover mahogany box with ivory-tipped forceps..... **$40.00**

15-30 SHORT BEAM ANALYTICAL BALANCE.

Capacity, 200 grams.

Sensitiveness, 1/10 mg.

Diameter of Pans, 3 inches.

Width of Pan Support, 4 inches.

Aluminum Beam, 6 inches long divided full length from 0 at center into 1/10 mg. divisions.

Rider Adjustment, single hook type, has full, clear sweep of entire length of the beam.

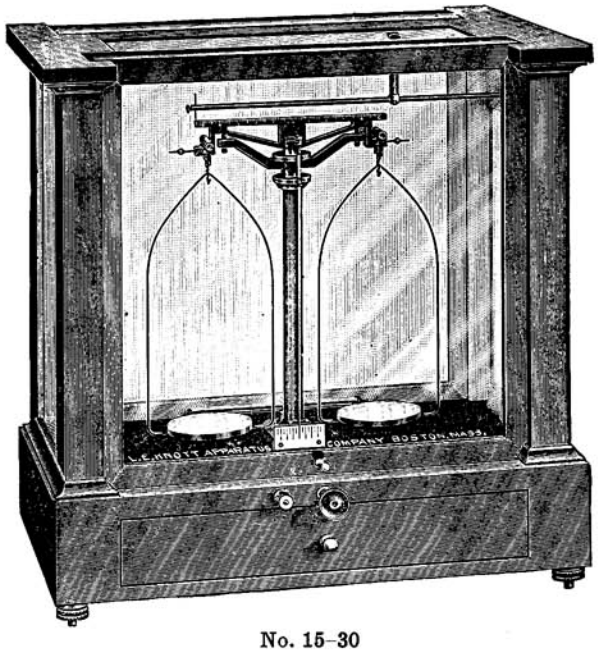
Independent Pan Arrest and **Beam Hoist.**

Bearings and Knife Edges of agate.

Mounting, polished mahogany case, front and back sashes movable up and down; front sash counterpoised. Mounted on drawer base.

With bench for specific gravity determinations and metal stand and counterpoise for weighing tubes.

PRICE, $110.00



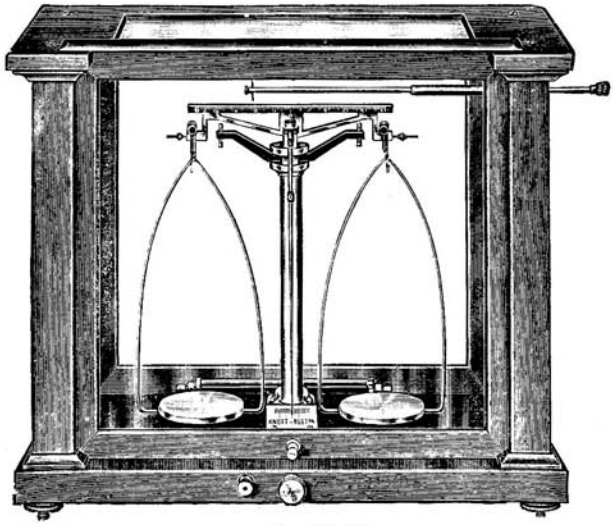
No. 15-30

KNOTT'S IMPROVED ANALYTICAL BALANCE

No. 15–40

Capacity 200 Grams; Sensitiveness 1/5 Milligram

Built To Our Order For Quantitative Work In Industrial and Educational Institutions



No. 15–40

This balance has most of the refinements of the highest-priced analytical balances. We have been enabled to retain these refinements by quantity production only. The design is the result of a careful review of the requirements of such a balance and the same care is exercised in the construction as is exercised in making the balances of much higher price. Rigid, painstaking tests fully warrant the statement that we believe that it is superior in design, construction, and finish to any analytical balance of equal or considerably higher price.

SPECIFICATIONS

Capacity, 200 grams.

Sensitiveness, 1/5 milligram.

Pans, Polished nickel silver, 3 inches diameter.

Bows, Hand-drawn, nickel silver wire, 4 inch-spread.

Beam, Aluminum, 6 inches long, graduated both sides of center knife edge in 1/10 milligram, white graduations on black background.

Knife Edges and Planes, of agate throughout.

Case, Seasoned polished mahogany, 17¾ inches long, 9 inches wide, 16 inches high, with counterpoised front door and glass top. Mounted on base board provided with leveling screws.

Rider Carriage, Simple, yet effective construction, free from possibility of derangement.

Pan Arrest, Self-locking adjustable push button type.

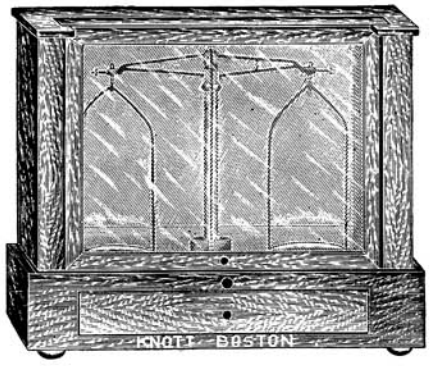
Beam Hoist, The knurled head noted in illustration in the center front of base operates a simple lever which raises or lowers the beam.

Finish, All brass parts black oxidized finish. Pans and bows polished bright.

PRICE, $50.00

15–42 ——, same as above, but **mounted on drawer base** (like **No. 15–30** listed on previous page)..... **$65.00**

We urge a thorough comparison of the many refinements in this balance with those of analytical balances of equal price and even of higher price, of either American or foreign make.

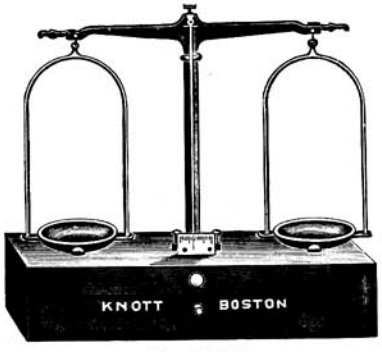


No. 15–46

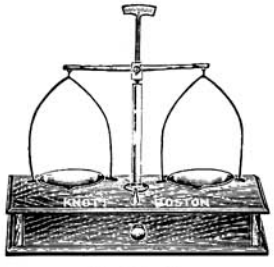
15–46 **H-K SCHOOL BALANCE,** capacity 100 grams, sensibility ½ mg., steel edges and planes, enclosed in case. Beam is of open truss construction and is provided with simple beam hoist. Edges and planes are carefully ground and polished. Pans, 7.5 cms. in diameter, are detachable. The balance is mounted in glass case on drawer base with screw feet and level. Case has counterpoise slide front. Adjusting screws on ends of beam..... **$40.00**

15–47 ——, same as above but **with agate bearings**..... **45.00**

15–51 **C-M SCHOOL BALANCE,** capacity 50 grams, sensibility 1 mg., steel edges and planes accurately ground and polished. Similar to **No. 15–46,** but beam of lighter weight. Mounted on drawer base in glass case. Pans, 7.5 cms. in diameter, are detachable..... **35.00**



No. 15–70



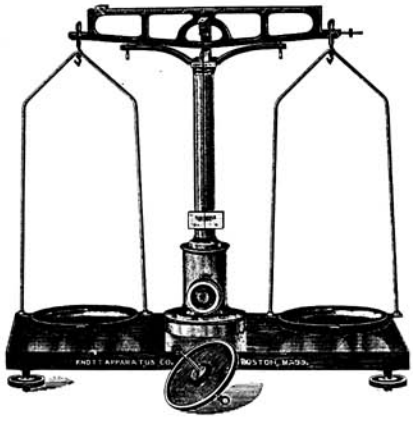
No. 15–80

15–70 **EQUAL ARM BALANCE,** capacity 50 grams, sensibility 1 cg., polished steel edges and planes, mounted on drawer base. Beam, 23 cms. long, closed construction with adjusting screws, is provided with eccentric lift. Pans, 7.5 cms. diameter. Balance is mounted on polished mahogany drawer base, is polished throughout, with lacquer and nickel-plate finish..... **18.00**

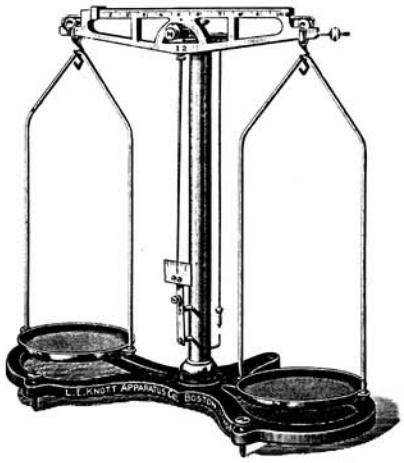
15–75 ——, similar in design to **No. 15–70,** but smaller and less sensitive. Beam 15 cms. long, pans 6 cms. in diameter, sensibility 3 cgs..... **16.00**

15–80 **EQUAL ARM BALANCE,** reliable for small weighings. Beam 15 cms. long. Pans 7.5 cms. in diameter, lever lift. Balance is nickel-plated throughout and is mounted on polished oak drawer base..... **6.75**

LABORATORY BALANCES



No. 15–100



No. 15–105

15–100 THE BOSTON LABORATORY BALANCE, 2000 grams capacity, sensitiveness with full load, less than ½ centigram.

Beam, 32 cms. long, open truss construction, with **Adjusting Screw.** Graduated full length with 0 at the left. A **Sliding Rider** gives readings up to 10 grams by 1-10 gram divisions.

Bearings and Knife Edges of polished steel, accurately adjusted.

Pans, 14 cms. diameter, are detachable.

Beam Arrest. A turn of the knurled head at the base of the pillar operates an eccentric movement within the pillar and lowers the beam to the Beam Arrest, thus removing weight from central knife edge.

Counterpoise provided to replace one of the stirrups in Specific Gravity work.

Plumb Bob — not shown in illustration — is attached to the pillar.

Mounting. A polished mahogany board on leveling screws.

Finish. Lacquered brass or nickel plate.

PRICE, $37.50

15–105 THE BAY STATE LABORATORY BALANCE, 2000 grams capacity, sensitiveness with full load, less than ½ centigram.

Beam, 32 cms. long, open truss construction, with **Adjusting Screw,** graduated full length with 0 at the left. A **Sliding Rider** gives readings up to 10 grams by 1-10 gram divisions.

Bearings and Knife Edges of polished steel accurately adjusted.

Pans, 14 cms. diameter, are detachable.

Damping Device. Simple, positive and rapid in action.

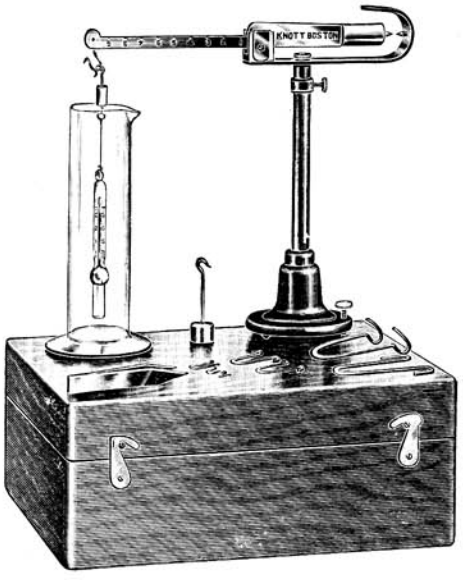
Adjustable Shelf for Specific Gravity Work (not shown in illustration). This shelf may be swung over one of the pans for supporting a jar or beaker of water for work in specific gravity.

Plumb Bob. Attached to pillar.

Mounting. Japanned iron base on leveling screws.

Finish. Nickel plate and japan.

PRICE, $22.00

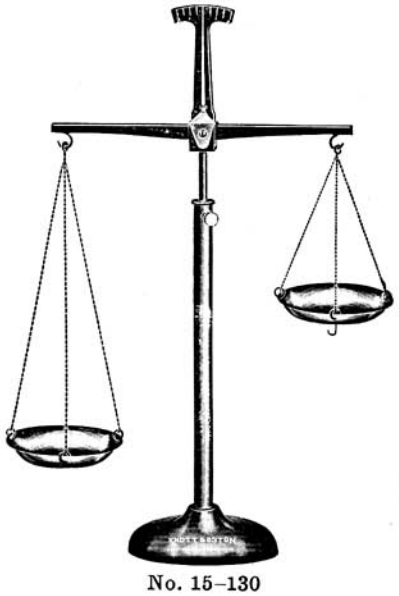


No. 15–122

No. 15–140

15–122 WESTPHAL'S SPECIFIC GRAVITY BALANCE for determining liquid densities. Accurate to fourth place of decimals. All parts of this balance are most carefully constructed. The polished mahogany box serves both as a carrying case and as a mounting for balance when in use. Each balance is furnished complete with jar, 8 riders, forceps, plummet and weight, in case..... **$30.00**

15–140 TRIPLE BEAM BALANCE, for rapid and accurate weighings in Physical or Chemical Laboratory. Capacity 111 grams, sensibility (guaranteed) 1cg. As name "Triple Beam" describes, this balance is constructed with **three beams so placed one above the other as to secure uniform weight upon the knife-edge.** The lower beam has a capacity of 100 grams by 10-gram divisions; the middle beam, 10 grams by single grams; the upper beam, 1 gram by 1/10 and 1/100 gram, each beam carrying an accurately adjusted weight attached movably to it. Base is substantially made of cast iron neatly japanned and is provided with sensitive spirit level and leveling screw. Upright neatly nickel-plated, carries an adjustable support for the receptacle in specific gravity experiments. At top of upright there is a knurled head which operates a simple lift for beam when not in use. Pan, 10 cms. in diameter, is detachable..... **25.00**



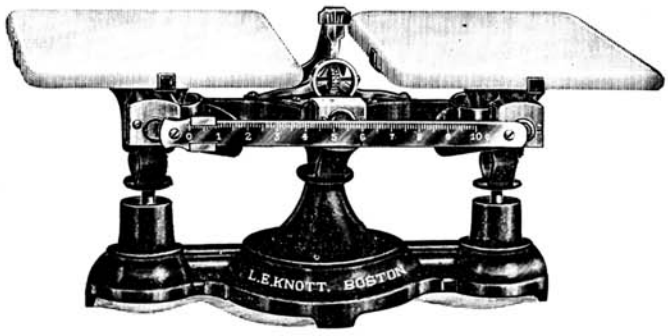
No. 15–130

15–130 HYDROSTATIC BALANCE, prismatic-steel knife-edges, mounted on japanned, round, iron base. Beam 8½ inches long is supported on polished steel knife-edges on planes held in a stirrup attached to the top of a brass rod which telescopes into a brass tube. The two pans attached by chains to hooks near the ends of the beam are 4 inches in diameter and are heavily nickel-plated. One pan is suspended by short lengths of chain and is provided with hook for experiments in specific gravity. The beam may be elevated, giving an adjustment of from 6 to 14 inches from the top of the table. This balance will be found satisfactory for experiments in specific gravity. It is of the best workmanship and handsomely finished throughout..... **13.50**

No. 15–200

15–135 SPECIFIC GRAVITY BALANCE, similar in design to **No. 15–130,** but smaller. Beam is 7½ inches long, pans 2½ inches diameter, adjustment of hook possible from 4½ to 10 inches..... **6.75**

15–200 HAND BALANCE, 7½-inch beam, first quality standard hand balance, hardened steel knife edges; horn pans 3 inches diameter; beam, lacquered brass..... **3.85**



No. 15-165

DESIGN. The center of gravity of the moving system is properly placed. Made of rigid cast metal, it will stand heavy loads without error. The knife-edges are held rigidly in position and cannot change. The equal length of the arms is absolutely assured.

No. 15-180

NEW FEATURES which have been added are noteworthy in the field of Balance Construction:

Method of Reading. By reference to the cut, it will be noted that we have adopted the straight line indicator which eliminates all errors due to parallax.

Long Graduated Rider Arm. The length of the **rider arm** has been greatly **increased** so as to give a wide, open scale with a range of 10 grams in 1/10 gram divisions.

Specific Gravity Hook. For convenience in specific gravity experiments, a **hook** is securely attached to **each platform post.**

Adjustment. The position of the **adjusting screw** is properly placed to avoid accidental displacement.

15-160 STEEL BEARING HARCOURT TRIP SCALE **$15.40**

15-165 AGATE BEARING HARCOURT TRIP SCALE. This scale, in addition to above important improvements, is provided with **six agate planes** accurately secured and set in rigid castings. The agate holders are cut with such a degree of nicety that we are able to guarantee the planes not to loosen or change position even to 1-1000 of an inch **19.90**

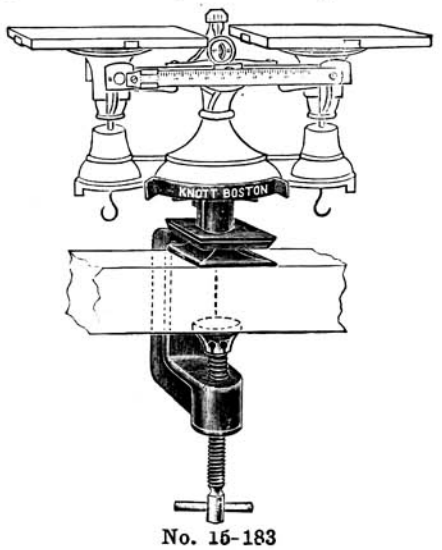
15-180 THE HARCOURT INTERLOCKING METAL TRIP SCALE SUPPORT for use on the table with above trip scales in specific gravity experiments. The design of the various parts of this support is such that danger of balance falling from support or being knocked from same is wholly obviated. The Harcourt Special H-Base is designed so that the 6×8 inch battery jar or other containing vessel may be placed directly under the suspending hook. Support only **5.50**

15-183 CROSS BAR T-BEAM TRIP SCALE SUPPORT, for use in supporting the trip scales above to the cross bar of Standard Physics Table **No. 1-100.** This support permits of use of trip scale crosswise or lengthwise of the table, enabling one to readily adjust the height of balance from top of table. Complete with clamp **3.50**

15-185 WOODEN SPREADER FOR HARNESS (see National Loose-Leaf Direction Sheets, Exp. **M041**) **.10**

15-186 WOODEN COUNTERPOISE (see National Loose-Leaf Direction Sheets, Exp. **M041**) ..... **.10**

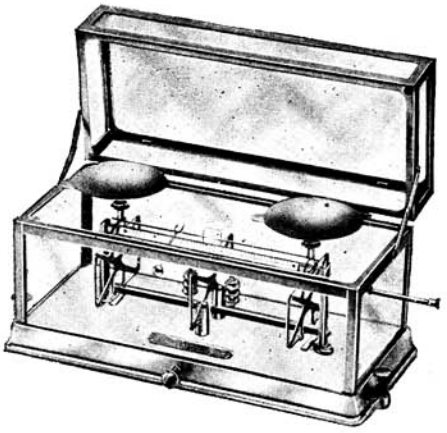
15-187 BRASS S-HOOK (see National Loose-Leaf Direction Sheets, Exp. **M041**) **08**



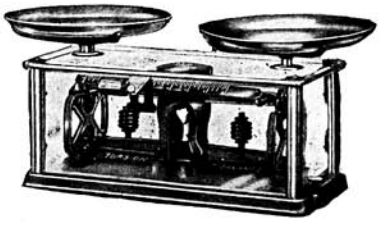
No. 15-183

TORSION BALANCES

The torsion, or twisting, of a steel band in this type of balance takes the place of the knife-edge fulcrum and. the two forces of torsion and gravity in continual opposition make the Torsion Balance very rapid in accurate work



No. 15–190

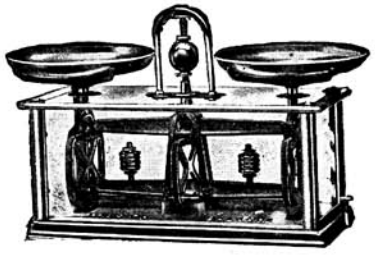


No. 15–191

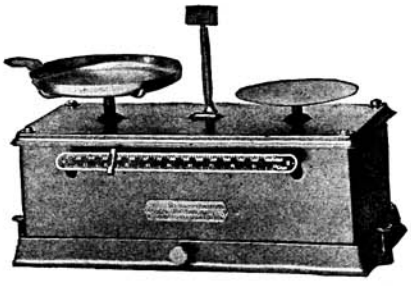
15–190 **GLASS-ENCASED TORSION BALANCE WITH GLASS COVER. Capacity 120 grams;** sensitiveness 2 mgs.; rider beam, 500 mgs. by 5 mgs.; pans of nickel silver, 3 inches diameter; with arrest; measurements over all, 13×6¼×6½ inches..... **$66.00**

15–191 **GLASS-ENCASED COUNTER TORSION BALANCE. Capacity 4½ kilos;** sensitiveness 1/5 gram; beam length, 12 inches; slide beam, 100 grams by 1 gram. Brass pans, 9 inches diameter; with arrest and external slide weight mover; measurements, 20½×9¾×9½ inches. **66.00**

15–191A ——, same as above, but without slide beam..... **61.00**



No. 15–192



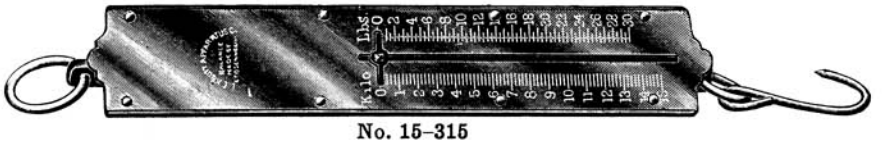
No. 15–194

15–192 **HIGH POISE GLASS-ENCASED LABORATORY TORSION BALANCE. Capacity 4½ kilos;** sensitiveness 1/15 gram; beam length, 12 inches. Nickel-plated brass pans, 8 inches diameter; with arrest, with high poise; measurements, 19½×11¾×8½ inches **66.00**

15–192A ——, same as above, but with slide beam graduated 100 grams by 1 gram..... **71.50**

15–194 **TORSION DISPENSING BALANCE** for chemical and general work. **Capacity, 500 grams (16 oz.)** sensitiveness, 16 mgs. (¼ grain); lower slide beam graduated 10 grams by 1/10-gram divisions; upper, 150 grains by 1-grain divisions. Nickel silver pans, 5 inches diameter; removable arrest for quick weighing. Gold-finished case, 13×6×8¼ inches..... **42.00**

No. 15–310 No. 15–300



No. 15–315

No. 15–332

No. 15–375 No. 15–365 No. 15–250

15–250 **IMPROVED JOLLY BALANCE** for determinations of weight by measuring the elongation of a spring, for determinations of specific gravity, for measurement of surface tension, and for study of Hooke's Law, etc. Without jar, but otherwise complete as illustrated including two aluminum scale pans, plummet, and two springs, one high and one low tension **$15.50**

15–251 **JOLLY BALANCE SPRING, low tension** ..... **.75**
15–252 **——, high tension** ..... **.75**

FLAT BACK SPRING BALANCES
Double Scale

Double pointer for readings in vertical and horizontal positions.

15–300 ——, **250 grams** by 10-gram divisions, **and 8 oz.** by ¼-oz. divisions **1.50**
15–305 ——, **500 grams** by 20-gram divisions, **and 16 oz.** by ½-oz. divisions **2.65**
15–310 ——, **2000 grams** by 25-gram divisions, **and 64 oz.** by ½-oz. divisions ..... **.90**
15–315 ——, **15 kilograms** by 200-gram divisions, **and 30 lbs.** by ¼-lb. divisions **3.50**

15–320 **FLAT BACK DOUBLE SCALE SPRING BALANCE WITH CORRECTION SCALE,** 10¼ inches long, **4-inch index.** Double scale: **500 grams** by 10-gram divisions, **and 18 oz.** by ¼-oz. divisions. In this balance the graduations are continued above the 0 point so that corrections can be made for weight of pointer when balance is in various positions. Both ends of index pointer are drawn to a sharp indicating point **4.25**

LABORATORY DYNAMOMETERS
Adapted Especially for Work in Practical Physics

15–330 ——, **10 lbs.** by ¼-lb. divisions, length 3⅜ inches **1.70**
15–332 ——, **20 lbs.** by ¼-lb. divisions, length 8 inches **3.30**
15–334 ——, **60 lbs.** by ½-lb. divisions, length 9½ inches **5.00**

15–360 **SPRING BALANCE CRADLE, metal,** for holding **Nos. 15–300** to **15–310** in a horizontal position .. **.20**

15–365 **SPRING BALANCE CRADLE, wood,** for **No. 15–315** Spring Balance ..... **.95**

15–375 **RINTOUL'S SPRING DYNAMOMETER,** a demonstration spring balance in which the spring can be reset to allow for variations in zero reading. Can be used as an accurate spring balance reading from 1 to 250 grams, or ¼ oz. to 8 oz. Metal construction throughout **2.90**

PRECISION AND ANALYTICAL WEIGHTS

Turned from hard-drawn brass rod, adjusted to **Highest Degree of Accuracy.** Gold-plated; fractional weights, 500 to 10 mgs., of platinum; smaller, of aluminum. With ivory-pointed forceps and camel's hair brush, in velvet-lined, polished mahogany case with removable lid.

No. 16–50

Nos. 16–80 to 16–100

16–50 ——, 1 mg. to 50 grams **$25.00**

16–52 ——, 1 mg. to 100 grams **28.00**

16–80 **ANALYTICAL WEIGHTS, single weights,** gold-plated, minutely adjusted, as used in sets **Nos. 16–50** and **16–52.**

	a	b	c	d	e	f	g
Size, grams	1	2	5	10	20	50	100
Each	**$1.20**	**$1.50**	**$1.90**	**$2.70**	**$3.20**	**$3.80**	**$4.80**

16–90 **ANALYTICAL FRACTIONAL WEIGHTS, single weights,** — 500 to 10-mg. weights of platinum; 5 to 1-mg. weights of aluminum, as used in sets **Nos. 16–50** and **16–52.**

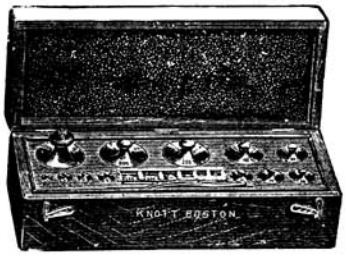
	a	b	c	d	e	f	g	h	i
Size, mgs.	1	2	5	10	20	50	100	200	500
Each	**$0.40**	**$0.40**	**$0.40**	**$0.60**	**$0.70**	**$0.90**	**$1.50**	**$2.20**	**$3.90**

16–100 **ANALYTICAL RIDER WEIGHTS, single weights** of solid gold.

	a	b	c	d	e
Size, mgs.	1	2	5	10	12
Each	**$0.65**	**$0.60**	**$0.35**	**$0.35**	**$0.35**

TECHNICAL WEIGHTS

Turned from hard-drawn brass rod, lacquered and then **carefully adjusted.** Fractional weights, 500 grams to 10 mgs., of nickel silver; smaller, of aluminum.



No. 16–154

No. 16–178

With forceps, in hinged-cover, polished mahogany case:

16–150 ——, 1 mg. to 20 grams **$5.50**
16–151 ——, 1 mg. to 50 grams **6.25**
16–152 ——, 1 mg. to 100 grams **7.50**
16–153 ——, 1 mg. to 200 grams **8.75**
16–154 ——, 1 mg. to 500 grams **11.50**

In Polished Wood Block with Forceps:

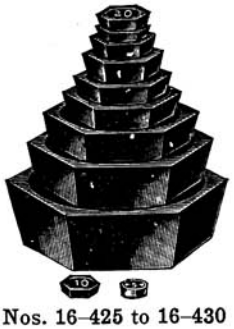
16–175 ——, 1 mg. to 20 grams **$4.75**
16–176 ——, 1 mg. to 50 grams **5.50**
16–177 ——, 1 mg. to 100 grams **6.75**
16–178 ——, 1 mg. to 200 grams **8.00**
16–179 ——, 1 mg. to 500 grams **10.75**
16–180 ——, 1 mg. to 1000 grams **12.50**

No. 16–227

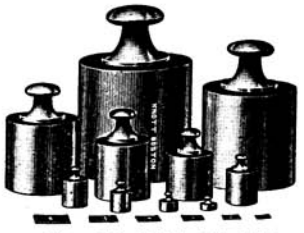
No. 16–230

16–225 **ALL-IVORY FORCEPS,** 11 cms. long, best quality **$2.50**
16–227 **IVORY-POINTED BRASS FORCEPS,** 11 cms. long **1.60**
16–230 **LACQUERED BRASS FORCEPS,** 10 cms. long ..... **.30**
16–250 **FLAT CAMEL'S-HAIR BRUSH,** ½ inch wide, best quality ..... **.22**

Nos. 16–300 to 16–302

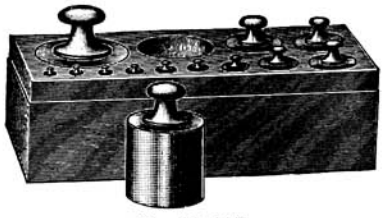


Nos. 16–425 to 16–430



Nos. 16–350 to 16–355

Nos. 16–310 to 16–315



No. 16–327

No. 16–440

No. 16–370

GENERAL LABORATORY WEIGHTS

BRASS WEIGHTS

Recommended for ordinary weighings. Fractional weights of hard alloy.

In hinged-cover hardwood box, fractional weights in hinged-cover compartment:

16–300 **——, 1 cg. to 50 grams** **$4.00**
16–302 **——, 1 cg. to 100 grams** **4.50**

In block, fractional weights in hinged-cover compartment:

16–310 **——, 1 cg. to 20 grams** **2.75**
16–312 **——, 1 cg. to 50 grams** **3.50**
16–315 **——, 1 cg. to 100 grams** **4.00**

In polished hardwood block without fractional weights:

16–325 **——, 1 gram to 500 grams** **8.25**
16–327 **——, 1 gram to 1000 grams** **12.00**

16–350 **SEPARATE BRASS WEIGHTS:**

	a	b	c	d	e	f	g	h	i	j
Size, grams	1	2	5	10	20	50	100	200	500	1000
Each	**$0.14**	**$0.15**	**$0.16**	**$0.24**	**$0.30**	**$0.50**	**$0.70**	**$1.00**	**$1.50**	**$3.00**

16–355 **SEPARATE FRACTIONAL WEIGHTS** of nickel silver:

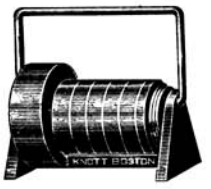
	a	b	c	d	e	f	g	h	i
Size, milligrams	1	2	5	10	20	50	100	200	500
Each	**$0.10**	**$0.10**	**$0.10**	**$0.10**	**$0.10**	**$0.10**	**$0.10**	**$0.10**	**$0.10**

16–360 **FRACTIONAL WEIGHTS,** one each of weights under **No. 16–355,** with duplicates of the 2, 20 and 200 mg. weights, in cardboard box **1.20**
16–370 ——, in wooden slide top box with compartments for weights **2.00**
16–380 **AVOIRDUPOIS BRASS WEIGHTS,** ⅛ **oz. to 1 lb.,** in block **8.75**
16–385 **TROY BRASS WEIGHTS,** ½ **grain to 1 oz.,** in block **3.50**

IRON WEIGHTS

16–425 **OCTAGONAL IRON WEIGHTS, 5 grams to 1 kilogram.** ..... Set **3.00**
16–430 **——, 5 grams to 2 kilograms.** ..... Set **4.50**
16–440 **DISC IRON WEIGHTS,** 1, 2, 4 and 8-oz. weights, with duplicate of the 1-oz. ..... Set **1.10**

No. 16–450



No. 16–460

16–450 **INTERHOOKING LABORATORY WEIGHTS, accurately adjusted hexagonal weights** of 10, 20, 50, 100, 200, 500 and 1000 grams, each with inset ring at the bottom and hook at the top so that one weight may be attached to another. One each of above weights, with duplicates of 20 and 200 gram, in cast metal holder **$6.75**

16–452 **——, without Cast Metal Holder** **5.25**

16–453 **CAST METAL HOLDER** as used in **No. 16–450** **1.50**

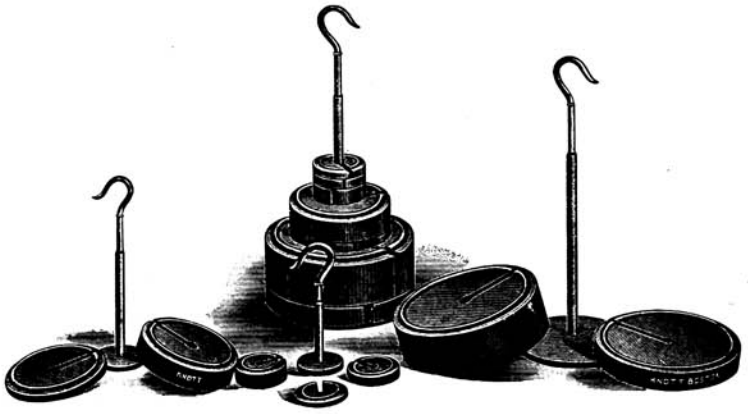
16–460 **SLOTTED METRIC WEIGHTS WITH HOLDER, accurately adjusted.** Set consists of 1–500, 5–100, 1–50, 2–20, and 1–10-gram weight. Complete as illustrated **5.00**

16–478 **SLOTTED METRIC WEIGHTS** as used in set listed above.

	a	b	c	d	e
Size, grams	10	20	50	100	500
Each	**$0.35**	**$0.40**	**$0.50**	**$0.65**	**$0.85**

16–479 **WEIGHT HANGER adjusted to 50 grams,** for use with above weights ..... **.85**

CAST IRON ADJUSTED METRIC WEIGHTS



Nos. 16–485 to 16–500

Slot slightly narrower than diameter of center hole. Each weight with groove and raised ring so that weights may be piled one on top of the other without danger of slipping.

16–485 **——, separate weights.**

	a	b	c	d
Size, kilos	½	1	2	5
Each	**$0.85**	**$1.15**	**$2.00**	**$4.00**

16–487 **500-GRAM WEIGHT HANGER, adjusted.** Pratt Institute Design. Above weights cannot be knocked off hanger accidentally **$1.15**

16–489 **ADJUSTED METRIC WEIGHTS AND HANGER.** One each of weights under **No. 16–485** and Hanger **No. 16–487** **9.00**

UNADJUSTED CAST IRON WEIGHTS

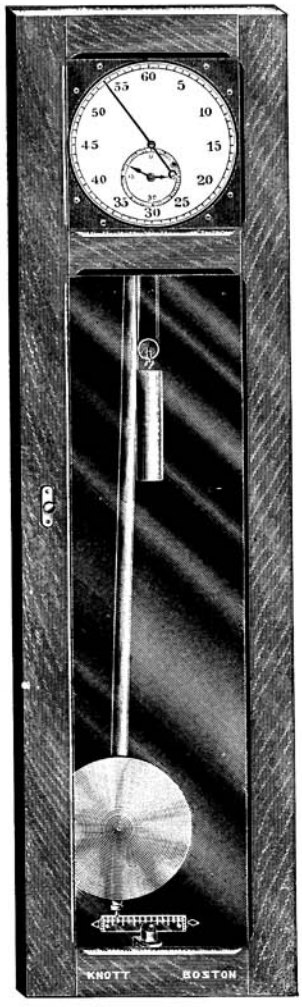
Slot slightly narrower than the diameter of center hole. Each weight with groove and raised ring so that weights of same diameter may be piled one on top of the other without danger of slipping. Weights are interchangeable on hangers of either series. Hangers of Pratt Institute Design vary in size and capacity.

	SERIES 1				SERIES 2			SERIES 3		
	Weights		Hanger		Weights		Hanger	Weights		Hanger
16–500	a	b	c	d	e	f	g	h	i	j
Size, lbs.	¼	½	1		2	5		10	20	
Each	**$0.22**	**$0.30**	**$0.45**	**$0.95**	**$0.60**	**$1.45**	**$1.25**	**$2.50**	**$4.75**	**$2.10**

50-lb. Weight and 50-lb. Hanger, see **Nos. 29–167** and **29–169.**

TIME — INDICATORS — SPEED

CLOCKS, PENDULUMS, METRONOMES, ETC.; SPEEDOMETERS



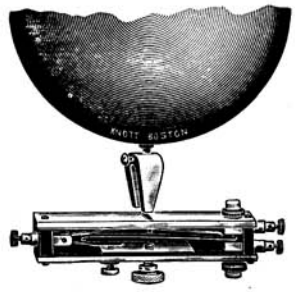
No. 17–10

17–10 LABORATORY CLOCK for general use as an accurate time-keeper and for beating seconds.

This clock has an eight-day, standard movement, weight-driven, and we guarantee its reliability as an accurate time-keeper. The lens-shaped bob is of polished brass and the pendulum is full seconds length, the center of oscillation being readily adjusted by means of a thumb-screw. The new dial (not shown in the illustration) has been thoroughly redesigned to give greater utility.

The mercury well is of improved design, exposing a thin strip of mercury adjusted by means of an easily-accessible knurled thumb-screw. The graduated arc affords an excellent, simple device for leveling, when setting up the clock in the laboratory.

The case of our clock is of polished mahogany, designed practically dust-proof. It is, in appearance, equal to the excellent quality of the movements which it contains. It is provided with binding posts for electrical connections for attaching battery and sounder..... **$150.00**



No. 17–15

17–15 MAGNETIC CLOCK CONTACT for attachment to any laboratory clock, making an adjustable positive contact that cannot get out of order. The design of a magnetic clock contact was first suggested to avoid the disagreeable features accompanying a mercury contact. The contact is positive and the make-and-break instantaneous. It is readily attached to any seconds pendulum, or any make laboratory clock with swinging pendulum. Complete, ready for attachment..... **19.25**

17–25 INTERVAL TIMER. This is a well-made, handsomely nickel-plated and reliable interval timer especially valuable in all experiments in which action for a definite length of time is necessary. The alarm may be set to ring at the expiration of any interval from one-quarter of a minute up to two hours. Complete with directions..... **5.00**

No. 17–25

No. 17–50

No. 17–60

No. 17–75

No. 17–90

No. 17–150

No. 17–120

No. 17–165

17–50 **FULL SWEEP SECONDS PENDULUM,** an inexpensive timing device beating intervals of one second — a full sweep seconds pendulum with lens-shaped bob suspended on ground and polished steel knife edges. The mercury well is of steel and designed to expose a thin strip of mercury, the height of which may be adjusted. The well and pendulum is in an electrical circuit through the binding posts. With adjustable contact tip..... **$12.75**

17–55 **FLASH SECONDS PENDULUM** (see National Physics Direction Sheets, Exp. S010) **2.65**

17–60 **ZINC AND IRON COMPENSATING PENDULUM,** illustrating employment of metals having different coefficients of expansion, in keeping constant the distance between the center of suspension and the center of oscillation. Mounted on an improved base..... **22.75**

17–75 **COMPENSATING MERCURY PENDULUM** — a modification of the Graham's Mercury Pendulum. A seconds pendulum in which the disc bob is replaced by two mercury wells in suitable holders. Complete as illustrated with stirrup, but without mercury..... **15.75**

17–90 **CLOCK DEMONSTRATION BALANCE WHEEL** for showing the principle of the self-regulating balance wheel in watch and clock movements. The two compound bars are electrically welded and are mounted in connection with the spiral spring..... **8.75**

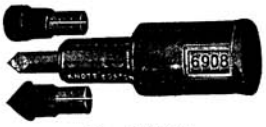
17–120 **METRONOME** for interval timing in laboratory experiments. Marker operated by spring-driven clock-work enclosed in polished mahogany case..... **6.25**

17–125 **METRONOME WITH BELL,** same as **No. 17–120,** but with bell attachment which can be regulated to sound every beat, every second, third, or fourth beat, as desired..... **8.50**

17–150 **STOP WATCH** — indispensable for accurate determination of time intervals. Excellent quality, stem wind, lever movement, beating one-fifth seconds..... **11.00**

17–165 **STOP CLOCK WITH SECONDS HAND, 5-inch dial.** Can be hung on wall or placed on a table or shelf. An accurate time-keeper, especially desirable in class-room demonstration..... **17.75**

No. 17-300



No. 17-305

No. 17-310

No. 17-325

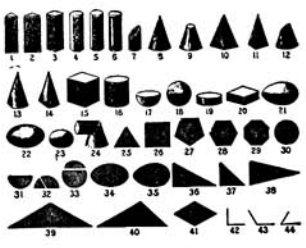
17-300 **IMPROVED SPEED COUNTER** for measuring speed of rotation of shafts in efficiency experiments, etc. The indicating dial is graduated into one hundred parts and graduations show every revolution and with two rows of figures which read both right and left..... **$1.50**

17-305 **SELF-REGISTERING SPEED COUNTER.** Registers up to 9,999 revolutions on low or high speeds up to 5000 r.p.m. Registers in either direction. When shaft turns one way the counter adds, the other way it subtracts. Complete with one pointed and one flat insulating tip..... **5.30**

17-310 **SELF-REGISTERING SPEED COUNTER.** Registers in either direction up to 99,999 revolutions. **2.25**

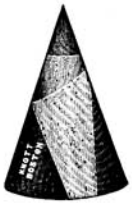
17-325 **SELF-REGISTERING HAND COUNTER.** Operated by slight hand pressure upon small lever shown in illustration. Complete with socket plate..... **5.10**

MATHEMATICAL MODELS



No. 18-10

No. 18-20



No. 18-30

18-10 **GEOMETRICAL WOODEN FORMS,** twenty-four solids accurately turned from hardwood, seventeen surfaces accurately cut out with steel dies from stiff, light-colored board; three angles represented by bent wires; all enclosed in wooden box with table of contents pasted on under side of cover **$3.25**

18-20 **CONE, SPHERE AND CYLINDER** for demonstrating that the volumetric contents of a cone, sphere and cylinder having the same diameters and heights, have a ratio as 1:2:3. The sphere will displace a volume of water which just fills the cone, three fillings of which fill the cylinder. Set **3.45**

18-30 **DISSECTIBLE CONE** for illustrating conic sections, circle, ellipse, parabola and hyperbola. Sections are of hardwood, highly polished on the surface..... **5.75**

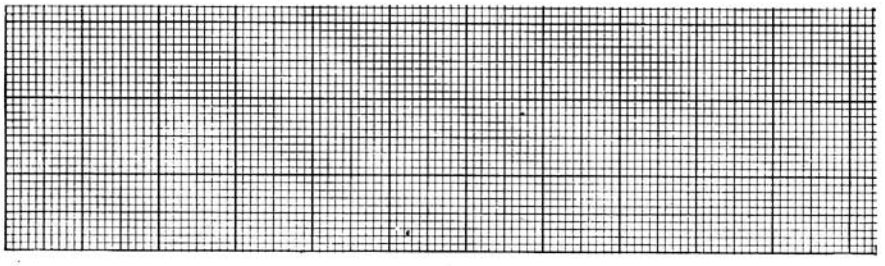
18-52 **BRASS DISC,** 8cm. diam. (See Millikan, Gale & Bishop, Exp. 1.) With zero mark..... **.75**

18-55 **HOLLOW BRASS CYLINDER,** with glass cover. (See Millikan, Gale & Bishop, Exp. 2)..... **.95**

18-200 **CRYSTAL MODELS OF WOOD,** thirteen different forms, representing the most common crystal formations. In cardboard box..... **1.25**

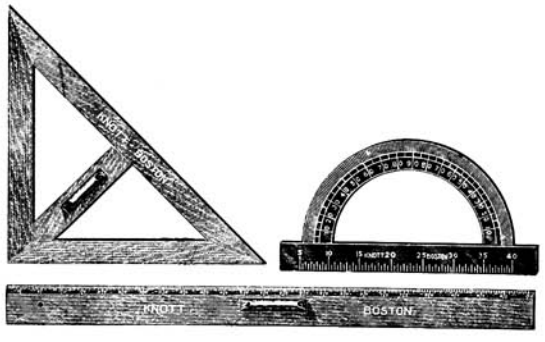
DRAWING INSTRUMENTS

No. 19-23



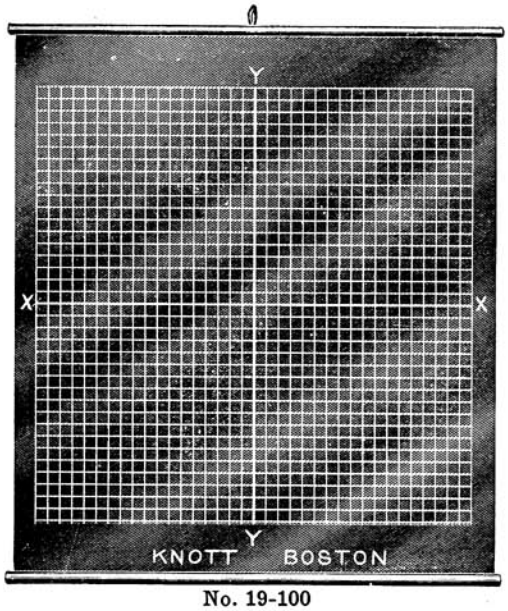
Nos. 19-67 to 19-68

19–23	**UNIVERSAL PENCIL COMPASS** for students use in making diagrams. Complete with pencil.	**$0.40**
19–30	**PARALLEL RULE,** best quality, made of clear ebony with brass mountings. Length 12 inches. . . .	**1.40**
19–32	**T-SQUARE,** cherry wood, 24 inches long, with fixed cross head	**.50**
19–40	**PEARWOOD TRIANGLE,** framed, extra quality, 30 degrees. Size 10 inches	**.45**
19–41	———, same as above, but 45 degrees. Size 8 inches	**.45**
19–42	**TRANSPARENT AMBRO TRIANGLE,** 30 and 60 degrees. Size 10 inches	**.90**
19–43	———, same as above, but 45 degrees. Size 8 inches	**.90**
19–50a	**DRAWING BOARD, 16×21 inches,** clear grained pine, with end ledges, with two drawing surfaces	**1.50**
19–50b	———, **20×24½ inches**	**2.50**
19–50c	———, **23×31 inches**	**3.50**
19–65	**CROSS SECTION PAPER, 17×22 inches,** $\frac{1}{10}$-inch divisions, on heavy bond paper. . . . . Sheet	**.08**
19–67	———, **8½×10½ inches,** one mm. divisions with heavy cm. rulings, **15×20 cm.** Our National Physics Note-Book Cross Section Paper with holes punched for use in Harcourt Binder. . . . . Per 100 sheets	**1.25**
19–68	———, printed on drawing paper. . . . . Per 100 sheets	**1.50**
19–70	**BLACKBOARD DIVIDER AND COMPASS, 16 inches long**	**1.25**



No. 19-75

19–75	**EXTRA LARGE BLACKBOARD DRAWING INSTRUMENTS. Ruler full meter long, triangle 50 cm. long** with angles of 45 and 90 degrees, **protractor 40 cm. diameter** with linear and angular scales, the latter reading in two directions. Fully graduated — divisions and figures filled black. One set recommended for each science laboratory or lecture room. . . Set	**$12.75**

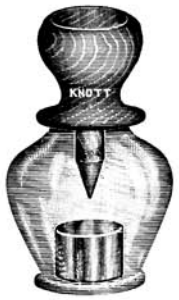


No. 19-100

19–75A	**BLACKBOARD DRAWING PROTRACTOR,** as used in above set	**$5.00**
19–77	**BLACKBOARD DRAWING INSTRUMENTS,** ordinary grade. . . . . Set	**7.50**
19–100	**GRAPH CHART, graph 36×36 inches,** lithographed on blackboard canvas, 3×4 feet, mounted on plain rollers with hook for hanging. Heavy lines accurately centered and squared, one-inch divisions	**6.25**

MECHANICS

PROPERTIES OF MATTER

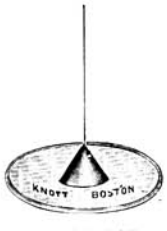


No. 20–10

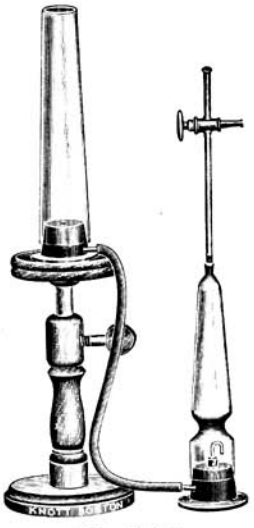
No. 20-90

No. 20–95

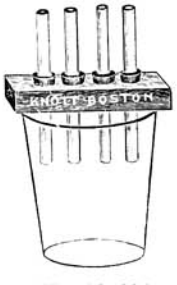
No. 20–115



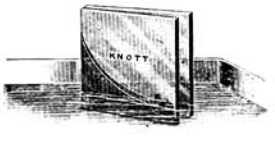
No. 20–117



No. 20–25



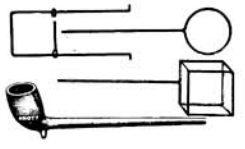
No. 20–134



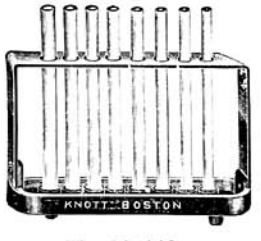
No. 20–125

No. 20–110

No. 20–130

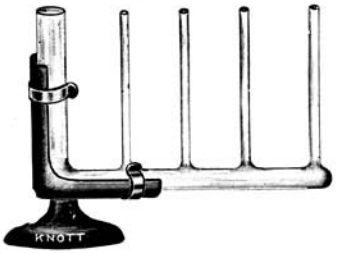


No. 20–100



No. 20–140

20–10	**POROSITY DEMONSTRATION APPARATUS** for demonstrating the porosity of wood. Complete as illustrated with special shaped wood funnel, bell glass, and glass dish	$3.15
20–11	**POROSITY DEMONSTRATION WOOD FUNNEL** as used in above	1.20
20–25	**JENKINS' SPECIFIC GRAVITY OF GAS APPARATUS** for specific gravity determinations. Used by gas inspectors of Massachusetts and New York. This apparatus employs, in principle, the effusion test of Bunsen, which is based on the fact that the specific gravities of two gases are inversely proportional to the squares of the speeds with which they escape through a minute opening. Complete with directions for use	22.50
20–90	**LEAD COHESION DISCS** for illustrating molecular cohesion between metals	1.20
20–95	**GLASS COHESION PLATES** for illustrating molecular cohesion between glass plates	.70
20–100	**FILM DEMONSTRATION APPARATUS** for illustrating characteristics of films, demonstrating surface tension and cohesion. Three wire forms and pipe. Set	1.50
20–110	**PRINCE RUPERT DROPS** for illustrating the stress existing between the outside and inside of glass when it is allowed to cool suddenly. Stress is overcome by breaking off small portion of glass, when the whole completely shatters. Per dozen	.95
20–115	**BOLOGNA PHIALS** for illustrating stress existing between the outside and inside of glass when it is allowed to cool suddenly. A few pieces of flint, if allowed to move about inside flask, overcomes the stress by causing small scratches which result in the bottom flying to pieces. Each	.25
20–117	**ADHESION DISC** for illustrating adhesion between glass and a liquid. Plate 3 inches in diameter	.60
20–125	**GLASS PLATES FOR ILLUSTRATING CAPILLARITY.** Per pair	.50
20–130	**TAPERING CAPILLARY TUBE** for demonstrating capillarity in tubes. Tapering glass tube, 4 inches long	.30
20–134	**CAPILLARY TUBES ON SUPPORT,** four tubes in a support for use on tumbler or small jar	.95
20–140	**CAPILLARY TUBES AND STAND,** eight tubes in metal stand on shallow cast iron basin base	2.15



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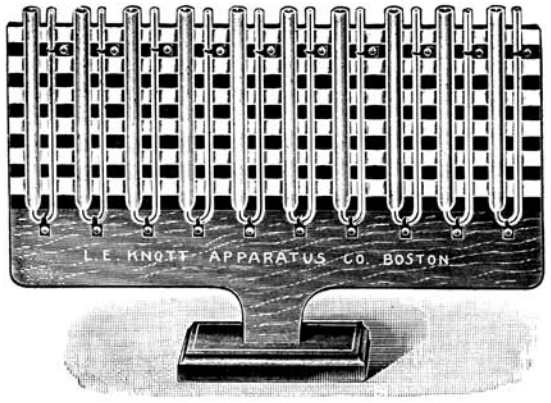
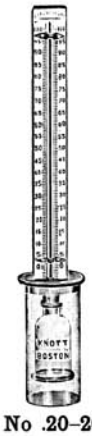


No. 20–160

No. 20–270



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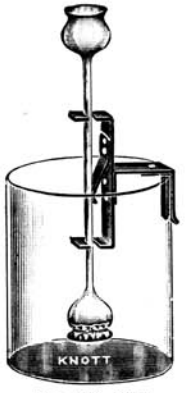
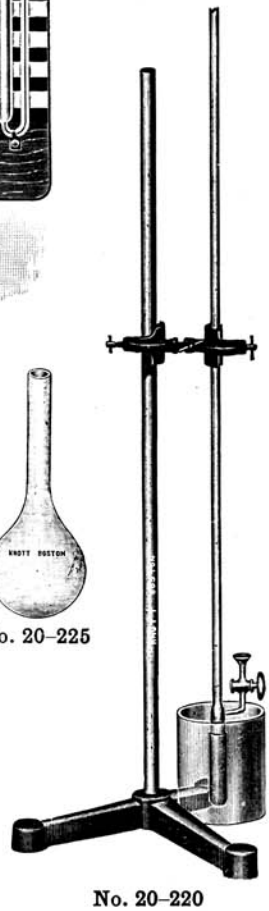


No. 20–215

No. 20–235

No. 20–260

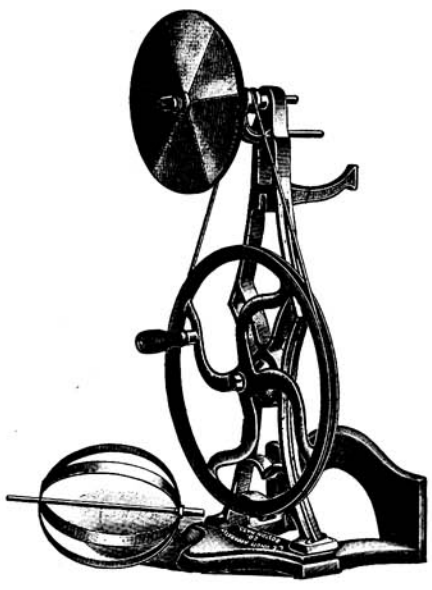
No. 20–225



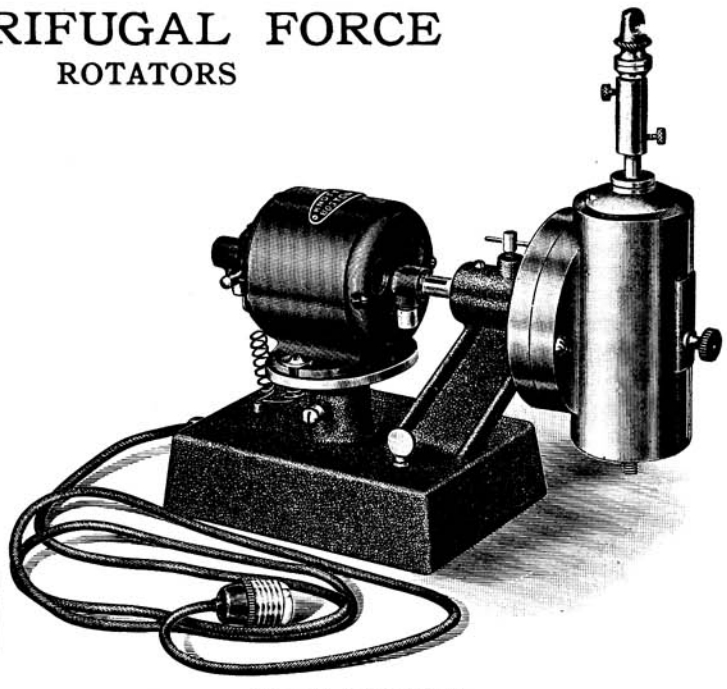
No. 20–220

20–145	**CONNECTING CAPILLARY TUBES AND WATER RESERVOIR,** as illustrated on stand under **No. 20–150.** Without stand	$1.25
20–150	**CONNECTING CAPILLARY TUBES AND WATER RESERVOIR, WITH SUPPORT.** Cast iron stand, brass clamps	3.25
20–160	**LARGE LECTURE TABLE CAPILLARITY ILLUSTRATION APPARATUS,** ten tubes of different capillary bore, each connected with reservoir and all mounted on support with scale for noting relative rise of liquid	12.00
20–200	**ENDOSMOMETER** for illustrating osmose and endosmose. Complete as illustrated with membrane	6.25
20–215	**STUDENTS' OSMOSIS APPARATUS** for illustrating osmosis qualitatively or quantitatively. Complete with jar as illustrated	2.50
20–220	**FREAS' OSMOSIS APPARATUS without supporting stand.** The tube is 5 feet long and heavy walled. With diffusion shell for lower end of tube	6.25
22–130	**UNIVERSAL STAND** recommended as support for **No. 20–220** above	4.95
5–850	**UNIVERSAL RIGHT ANGLE CLAMP** recommended for holding **No. 20–220** to the support	2.50
31–265c	**BATTERY JAR,** 6×8 inches, recommended for **No. 20–220** above	.60
20–222	**DIFFUSION SHELLS** as used in **No. 20–220** above. Each, **$0.45.** Per ten	4.50
20–225	**OSMOSIS BULB** for showing diffusion of gases. 70 mm. diameter. Should be used in connection with tight-fitting rubber stopper and glass tube	1.45
20–235	**HALL'S SURFACE TENSION APPARATUS** for quantitative measurement of surface tension. Complete with stand	4.95
20–235A	——, without stand	4.00
20–236	**SHALLOW FLINT GLASS DISH** as used in **No. 20–235**	.20
20–260	**IMPENETRABILITY APPARATUS,** illustrating that two bodies cannot occupy the same space at the same time. If bottle is filled with water and plunger pushed down into water, the bottle will break. Cast iron stand, japanned. Complete with three bottles	4.25
20–270	**INERTIA APPARATUS** for demonstrating inertia. Card, if given sudden blow will move forward suddenly, but ball does not change position except as gravity causes it to drop into concave top of upright post	1.85

CENTRIFUGAL FORCE
ROTATORS



No. 21–10



Nos. 21–30 to 21–35

21–10 **ZIEGLER 21-POUND MECHANICAL ROTATOR or WHIRLING TABLE** for rotating objects to which it is desired to apply a centrifugal force.

Important features distinctive in our design:

Unusual rigidity in either vertical or horizontal position secured by proper distribution of the mass (approximately 21 lbs.) to bring the center of mass as low as practicable.

Extra large drive wheel facilitating rotation by high or low speed.

Universal chuck for fastening an object with a spindle combined with a special lock-nut head designed for fastening plates, color discs, or other rotator accessories.

Without any of the illustrated accessories..... **$14.00**

21–30 **UNIVERSAL IMPROVED SPEED AND POWER ROTATOR, motor friction drive,** for rotating objects to which it is desired to apply centrifugal force. We offer in this rotator all the features heretofore offered, but with the addition of important perquisites of a continually efficiently operative motor rotator.

Universal Direction Adjustment. The countershaft housing is designed to rotate through a complete circle to give any desired direction.

Speed Control without Diminution in Power — a speed control never before obtained in a rotator — from 0 to 5000 R.P.M. By reason of the friction-drive method, the **power increases as speed decreases** giving almost **unlimited torque at very low speed.**

Reverse Rotation secured by movement of slow-motion screw which regulates the speed. Reverse rotation obtained without jar or shock, as no switch or reversing key is required.

Stability. The supporting base is a metal casting supported by shock-absorbing points and rests firmly and rigidly on the table.

Universal Chuck Socket which takes all whirling table attachments.

Safety. All moving parts are enclosed to eliminate possibility of injury. (Clamping screws for rotator chuck are shown projecting from chuck holder. As instrument is made, these clamping screws are set flush with holder and are slotted.)

The rotator is furnished with Edison Plug and 6-foot flexible cord. The **current control switch** which is indicated in the simplest possible manner in the cut, is a high-grade, flush switch set into the end of the base. The **speed counter** is directly connected with the shaft and gives the actual number of revolutions of the effective shaft. It can be thrown in or out of mesh at will while shaft is rotating. Rotator complete as above, the motor wound for 110-volt D.C. circuit..... **65.00**

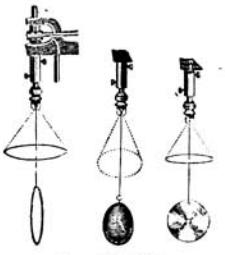
21–35 ——, the motor wound for 110-volt, 60-cycle A.C. circuit..... **65.00**

ROTATOR ACCESSORIES

No. 21–50

No. 21–100

No. 21–60

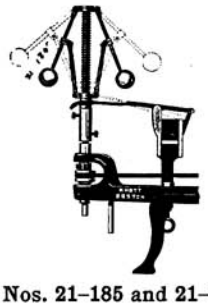


No. 21–110

No. 21–120

No. 21–150

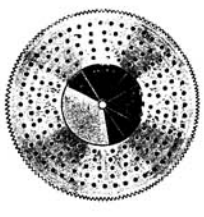
No. 21–80



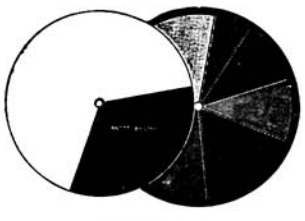
Nos. 21–185 and 21–190

No. 21–160

No. 21–175



No. 21–225



No. 21–210

21–45 **SPECIAL DRIVE PULLEY for round belt.** Designed with set screw for attaching to shaft of either **No. 21–10, 21–30** or **21–35.** An essential attachment when rotator is used as the driving mechanism of our Mechanical Equivalent of Heat Apparatus **No. 67–20,** or other apparatus..... **$2.25**

21–50 **SPEED INDICATOR** for attachment to Rotator **No. 21–10**..... **6.25**

21–60 **SPRING STEEL CENTRIFUGAL HOOP** for illustrating the tendency of a semi-fluid body, such as the earth, to assume a flattening at the poles when rotating rapidly..... **3.00**

21–80 **FOUCAULT'S PENDULUM** for illustrating conservation of the plane of oscillation. Wooden disc, quadrants clearly marked; polished brass uprights..... **9.90**

21–100 **CENTRIFUGAL FORCE APPARATUS**..... **4.25**

21–110 **CHAIN, EGG AND DISC** for illustrating the tendency of a body to rotate about its shortest diameter..... **1.10**

21–120 **TYNDALL'S INSULATED HEAT BY FRICTION ATTACHMENT** for illustrating heat caused by friction on a brass tube while rotating rapidly. In our design, the brass tube is insulated from the shaft which is attached in the chuck socket of the rotator. Complete with friction vise..... **4.85**

21–150 **CENTRIFUGAL SEPARATOR** for illustrating the separation, by centrifugal force, of solids held in suspension in a liquid..... **4.50**

21–160 **CENTRIFUGAL DRIER** for illustrating the principle of centrifugal devices used in laundries and in separation of juice from pulp of fruits, etc..... **5.85**

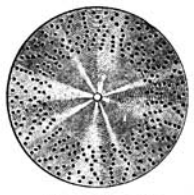
21–175 **TWO-IN-ONE GLASS ROTATOR GLOBE** for showing effect of rotation upon solids or liquids of unequal weight. This apparatus takes the place of the glass globe for liquids and dish for solids. **5.25**

21–185 **WATT'S GOVERNOR** for illustrating principle of an engine governor. (Principle best illustrated in conjunction with **No. 21–190**)..... **5.65**

21–190 **VALVE REGULATOR** for use with **No. 21–185** in illustrating method of regulating the flow of steam into the steam chest of an engine..... **5.40**

21–210 **LARGE LECTURE TABLE COLOR DISCS** for quantitative work in color mixing and analysis. Colors on heavy cardboard, each disc slit so that combinations of colors may be obtained. Percentage circular protractor, one disc of white, one disc of black, and one disc of each of the primary colors. Set..... **1.65**

21–225 **COMBINATION NEWTON'S COLOR DISC, SIREN DISC AND SAVART'S WHEEL** for showing that white light results when certain percentages of primary colors are exposed and rotated rapidly. Illustrates also the propagation of sound by mechanical disturbances which cause vibration in the surrounding media. The disc is perforated with four rows of holes equally spaced, and one row unequally spaced; the teeth are equally spaced..... **3.65**



No. 21–257

No. 21–305

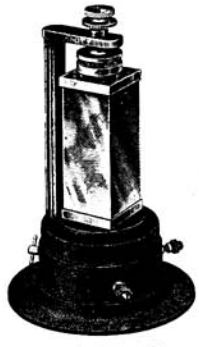
No. 21–240

No. 21–267

No. 21–280

No. 21–290

No. 21–295



No. 21–300

No. 21–310

21–240 **SAVART'S TOOTHED WHEELS** for demonstrating that musical tones are produced by regular impulses imparted to the surrounding media. Each of the four discs has teeth equally spaced. **$3.25**

21–242 **SAVART'S TOOTHED WHEEL,** one wheel same as above, arranged to attach to rotator..... **1.50**

21–255 **METAL SIREN DISC, five rows of holes,** illustrating propagation of sound by impulses imparted to the surrounding media. Four rows of perforations equally spaced produce musical notes; one row unequally spaced produces a noise..... **2.50**

21–257 **——, nine rows of holes.** Eight rows equally spaced produce musical notes; one row, unequally spaced produces a noise..... **2.95**

21–267 **AIR IMPULSE ATTACHMENT** for use with Siren Discs **Nos. 21–225, 21–255** and **21–257,** for directing one, two or more (up to nine) steady currents of air, as furnished by blower, against the holes. Each of the nine air valves is operated by a thumb screw..... **5.25**

21–230 **CROVA'S DISC AND METAL SHIELD** for attaching to rotator to illustrate compressional waves. Cardboard disc, 11 inches diameter, with eccentric circles clearly defined, and a metal shield, 12 inches in diameter, provided with slit for viewing a narrow strip of the eccentric circle segments..... **3.25**

21–280a **FLAT METAL SHIELD WITH ATTACHED CLAMP** as used in **No. 21–280**..... **2.75**

21–280b **CROVA'S DISC,** heavy cardboard, as used in **No. 21-280**..... **.50**

21–290 **CUBICAL or ROTATING MIRROR** for attaching to rotator for study of reflections from a rotating mirror or for manometric flame images. All metal work, finished dead black..... **6.25**

21–295 **KOENIG'S MANOMETRIC FLAME CAPSULE** for transmitting the motion of sound waves to a gas flame, which by their pulsations, indicate the nature of the sound at the mouth piece. The membrane is held between two metal castings..... **6.00**

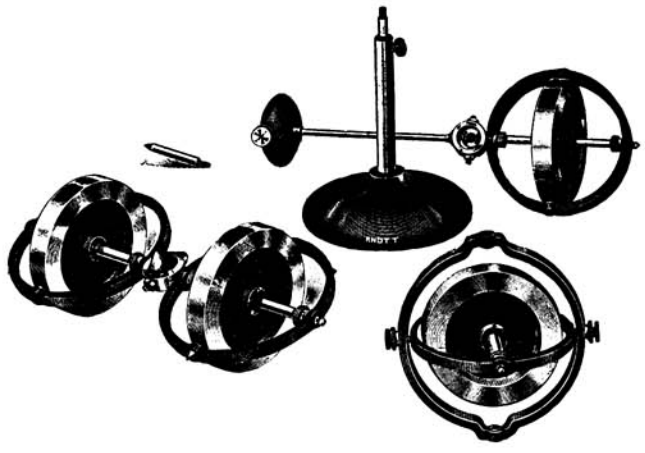
21–300 **VARIABLE SPEED ELECTRIC ROTATING MIRROR.** A new design of mounting for rotating mirror which gives a variable speed control, on from 4 to 6 volts, of from 30 to 120 complete revolutions per minute, covering the correct speed for all projection and sound pulsation or the vibrations of any fork. The resistance is mounted within the cast iron base, a worm and gear being mounted at the end of the motor shaft, which insures a uniform motion at any desired speed..... **25.00**

21–305 **ARAGO'S MAGNETIC ROTATION APPARATUS** for demonstrating the reaction between the electric currents induced in a rotating copper disc and a magnet. Illustrates also the damping effect of copper upon a magnetic needle. Glass plate, copper disc, magnetic needle and necessary supports with clamps for attaching to rotator..... **11.50**

21–310 **EARTH INDUCTION APPARATUS** for showing that currents are set up in a coil of wire by the inductive action of the earth as the coil is slowly rotated. Coil with commutator and collecting brushes, ready for attachment to rotator..... **15.50**

THE HARCOURT UNIVERSAL GYROSCOPES

No. 21-345



No. 21-340

No. 21-355

No. 21-350

No. 21-360

The plan on which these instruments are designed is that of using the simple or Basic Unit to demonstrate the simpler forms of gyroscopic phenomena, and to build up from this unit various gyroscopes to demonstrate the more complex phenomena.

The particular office of the integral parts has been most carefully studied and the designs of the various integral units are the result of much experimentation. Extreme care is exercised in machining and constructing the units, and every outfit is as nearly perfect in workmanship as skilled machinists can produce.

The various units are:

Rotating Wheel System Basic Unit — simple gyroscope wheel. This is a perfectly balanced cast brass wheel, 3½ inches in diameter, so designed that as much of the mass as practicable is kept as near the periphery as possible. This wheel has a steel axle and is carefully balanced by adjustable cone bearings in the gimbal ring stirrup. The lock nuts serve not only to hold the wheel in its gimbal ring, but also prevent the power string from catching in the bearing. One cone bearing has the protruding end fashioned to a point, the other bearing has the protruding end fashioned in form of a ball (see No. 21-360).

Stand with Reversible Cone- and Cup-Bearing Post. At the top of the upright of the stand is the removable reversible cone- and cup-bearing post. This serves to provide a suitable pivotal bearing, a threaded post for attaching any of the rings or the Gimbal Ring and Bearing, and also a cup support for the ball-bearing end of the main axle of the Basic Wheel Unit.

Extension Rod with Counterpoise. With addition of Gimbal Ring and Bearing, one is enabled to assemble a Counterpoise Gyroscope (see No. 21-355).

Gimbal Ring and Bearing. Gimbal ring is threaded both sides to take the exposed threaded end of the bearing in the Basic Wheel Unit, or the threaded end of the Extension Rod of above (see Nos. 21-345 and 21-355). The bearing is of steel and is mounted in steel cone bearings.

Bohnenberger Ring and Bearing for assembling a Bohnenberger Gyroscope (see No. 21-350).

Extension Rod Stilt Attachment for use on Extension Rod with Counterpoise to assemble a Stilt Gyroscope.

The complete outfit consists of:

2 Basic Wheel Units.
1 Stand with Reversible Cone- and Cup-Bearing Post.
1 Extension Rod with Counterpoise.
1 Gimbal Ring and Bearing.
1 Bohnenberger Ring and Bearing.
1 Extension Rod Stilt Attachment.
Complete Outfit **$31.50**

21-345 FESSEL'S COMPOUND GYROSCOPE consisting of 2 Basic Wheel Units, Stand with Reversible Cone- and Cup-Bearing Post, and Gimbal Ring and Bearing **26.00**

21-350 BOHNENBERGER GYROSCOPE consisting of Basic Wheel Unit, Stand with Reversible Cone- and Cup-Bearing Post, and Bohnenberger Ring and Bearing **17.50**

21-355 COUNTERPOISE GYROSCOPE consisting of Basic Wheel Unit, Stand with Reversible Cone- and Cup-Bearing Post, Gimbal Ring and Bearing, and Extension Rod with Counterpoise **18.75**

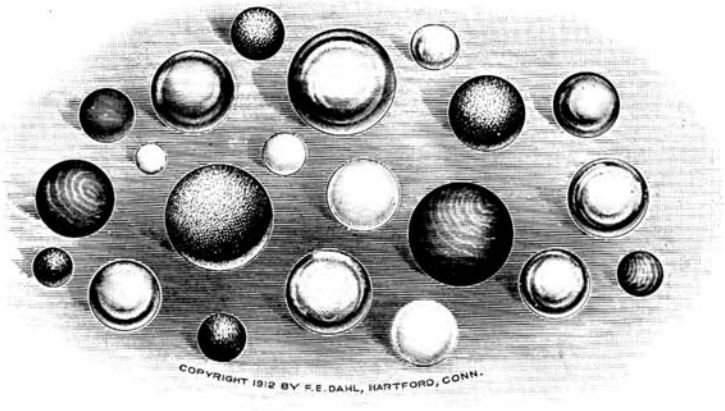
21-360 SIMPLE GYROSCOPE consisting of Basic Wheel Unit, and Stand with Reversible Cone and Cup-Bearing Post **14.00**

We recommend the purchase of the Complete Gyroscopic Outfit No. 21-340. The various units described under No. 21-340, however, may be added as required to Nos. 21-345, 21-350, 21-355 or 21-360, to assemble any type listed. (Prices on application.)

21-367 SIMPLE GYROSCOPE, light wheel, usual form, but not a toy **5.00**

ACTION AND REACTION

PENDULUM BALLS



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Nos. 22-10 to 22-110

22-10 WOODEN BALLS:

	a	b	c	d
Diameter, inches	3/4	1	1 1/2	2
Price	$0.10	$0.15	$0.25	$0.30

22-20 GLASS BALLS:

	a	b	c
Diameter, inches	3/4	1	1 1/2
Price	$0.10	$0.15	$0.45

22-30 IVORY BALLS, accurately turned, polished, and with a hole drilled for suspension:

	a	b	c
Diameter, inches	1	1 1/2	2
Price	$2.00	$2.50	$3.00

22-40 LEAD BALLS, made of cast metal, drilled for suspension:

	a	b	c	d
Diameter, inches	5/8	3/4	1	1 1/2
Price	$0.10	$0.15	$0.25	$0.55

22-50 BRASS BALLS, accurately turned, polished, drilled for suspension:

	a	b	c	d
Diameter, inches	1/2	3/4	1	1 1/2
Price	$0.15	$0.30	$0.50	$1.25

22-60 IRON BALLS, cast, **a, b,** and **c** drilled for suspension; **d** and **e** with hooks.

	a	b	c	d	e
Diameter, inches	3/4	1	1 1/2	2	3
Price	$0.20	$0.25	$0.60	$0.80	$1.25

22-61 MASSIVE IRON BALL WITH THREE HOOKS **$1.70**

22-70 HIGHEST GRADE STEEL BALLS, hardened, accurately ground and polished. There are no holes, but the small balls may be suspended by shellacking a thread to them.

	a	b	c	d	e	f
Diameter, inches	3/8	1/2	3/4	1	1 1/2	2
Price	$0.06	$0.10	$0.20	$0.30	$0.60	$2.00

22-72 STEEL BALL, with loop attachment for suspension, 1-inch diameter ..... **.75**

22-80 FINISHED LIGNUM-VITAE BALL, 1 1/2 inches in diameter ..... **.65**

22-90 COPPER BALLS, not turned but drilled for suspension:

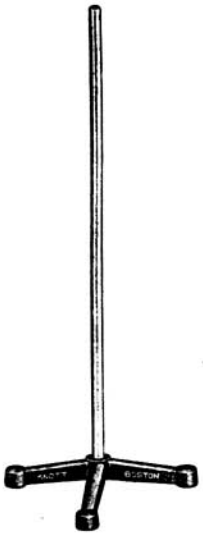
	a	b	c
Diameter, inches	3/4	1	1 1/2
Price	$0.22	$0.45	$1.25

22-100 CORK BALLS, lathe turned, and drilled for suspension:

	a	b	c
Diameter, inches	3/4	1	1 1/2
Price	$0.09	$0.15	$0.25

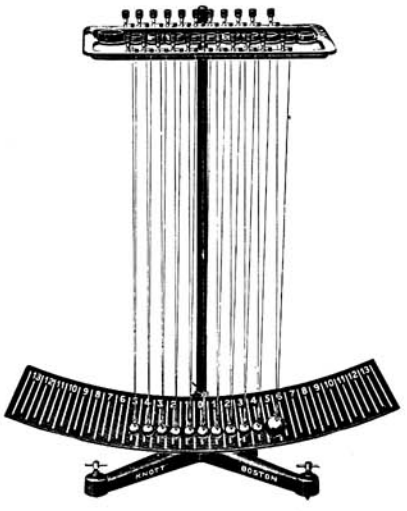
22-110 COMBINATION SET OF BALLS, for use in collision experiments, giving a variety of weights with approximately the same size. The set consists of 1 1/2-inch balls of cork, ivory, lignum-vitae glass, iron, brass, copper and lead. ..... Set **7.50**

ACTION AND REACTION APPARATUS



No. 22–130

No. 22–135



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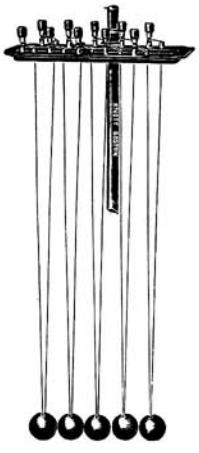


No. 22–190

22–130 UNIVERSAL STAND. A support rod and suitable tripod base are required as a support for many items. The most satisfactory selection is No. 5–20e Support Rod, 100 cm. long, 19 mm. diameter, and No. 5–155 Tripod Base, 21 cm. leg. To facilitate in ordering, we list these two items under the one number **$4.95**

22–131 ——, same as above, but tripod fitted with three nickel-plated leveling screws **6.20**

22–135 IMPACT APPARATUS, illustrating the resolution of one force into two equal forces by impact of equal masses. The special cast iron clamp attachment is fitted with a V-clamp to attach to a 10 to 19 mm. rod. The three balls are held in bi-filar suspension adjustable by knurled tapered plugs fitting into holes in the attachment. Without support **4.85**

22–145 IMPACT AND REFLECTION APPARATUS for determining the laws of impact, also law of incidence and reflection of light. The impact plate, V-clamp, and support for graduated half-circle of wood, are cast in one piece. At the end of one of the swiveled cast metal arms, is a spring gun; at the end of the other, a stop or bucket for receiving the ball after the rebound from the impact plate. When used for experiments on reflection of light, a mirror, which is provided, is clamped over the impact plate, the stop or bucket holds the candle, and the reflection is viewed through the peep-hole over the spring gun. Without stand **19.00**

No. 22–145

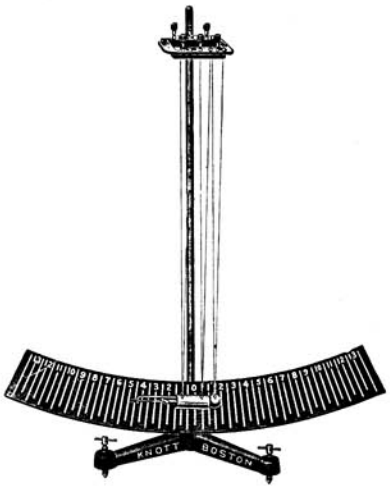
22–180 COLLISION BALL APPARATUS, ten steel balls in bi-filar suspension for qualitative or quantitative study of impinging elastic bodies. The center rib has recessed holes for holding the balls when not in use. Balls are held in bi-filar suspensions, lengths of which are adjusted by turning the knurled tapered plugs which, by friction in the holes into which they fit, hold the weight of the ball. Complete as illustrated with 10 steel balls, 1 inch in diameter, and one steel ball four times the mass of each of the other balls **29.25**

22–181 COLLISION BALL ATTACHMENT, supporting frame with steel balls in bi-filar suspension as used in No. 22–180 ..... **19.50**

22–182 GRADUATED ARC WITH ATTACHED CLAMP as used in No. 22–180 ..... **3.75**

22–131 UNIVERSAL STAND as used in No. 22-180 ..... **6.20**

22–190 COLLISION BALL APPARATUS for study of impinging elastic bodies. Rectangular metal frame with five elastic bodies in bi-filar suspension, adjustable by turning tapered plugs, held by friction in the holes into which they are fitted. Without support **9.75**



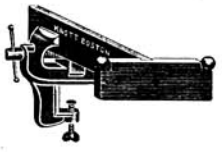
No. 22–200

22–200 **MOMENTUM APPARATUS** for deriving laws of momentum. The two bodies are held in bi-filar suspension adjusted by turning tapered plugs fitting into holes in the cast metal rectangular frame. The bodies have masses of ratio 1:4, the larger provided with spring gun striking attachment operative on both bodies at the same time. Complete as illustrated..... **$20.00**

22–201 **MOMENTUM ATTACHMENT** — the two bodies and supporting frame as used in **No. 22–200** above..... **10.25**

22–182 **GRADUATED ARC with ATTACHED CLAMP** as used in **No. 22–200** above..... **3.75**

22–131 **UNIVERSAL STAND** as used in **No. 22–200** above..... **6.20**



No. 22–220

No. 22–225

22–220 **SECOND LAW OF MOTION APPARATUS** — a flexible hardwood strip, two balls and vise as illustrated..... **3.10**

22–221 **BENCH VISE CLAMP** as used in **No. 22–220** above..... **1.85**

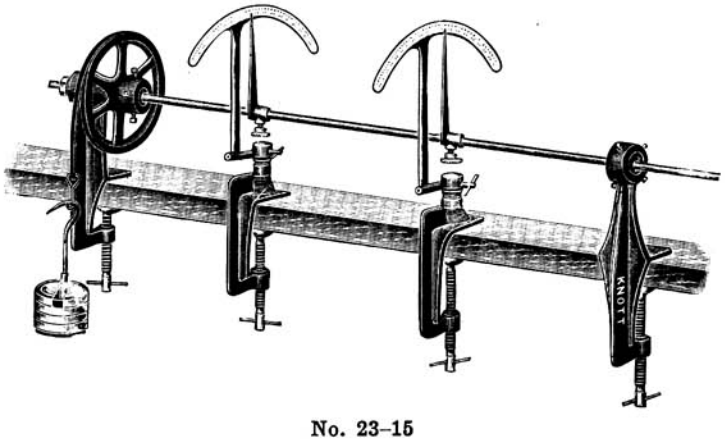
22–222 **FLEXIBLE HARDWOOD STRIP** as used in **No. 22–220** above..... **1.25**

22–225 **SECOND LAW OF MOTION APPARATUS** for use in hands. The rod to which the ball, within the glass tube, is attached, is pulled back against the spring. When released, the rod and attached ball fall to floor in parabolic path while the loose ball falls directly to the floor, both striking at the same instant..... **3.75**

22–230 **GAGE'S SECOND LAW OF MOTION APPARATUS** — a spring within a metal casting so actuates a rod that it will shoot forward one ball and allow a second ball to fall by force of gravity. In use, the metal casting should be attached to a block or to the top of the table..... **7.75**

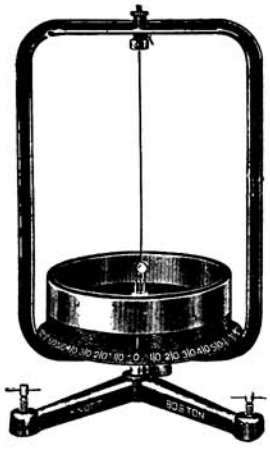
STRESS AND STRAIN

Torsion of Beams, Torsion of Wires, Rotational Vibration, Flexure of Beams Young's Modulus, Tensile Strength of Wires

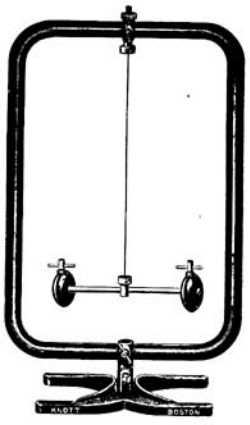


No. 23–15

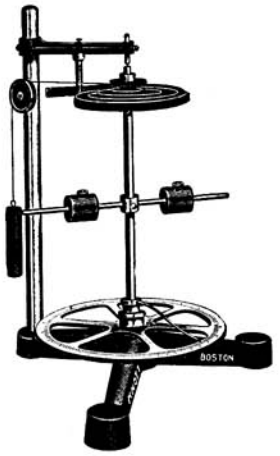
23–15 **HARCOURT TORSION APPARATUS** for determining the moment of torsion and the coefficient of torsional rigidity of rods of different lengths and diameters. The clamping heads for the rod are adjustable along the table to hold any length of rod; the pointers clamp directly to the rod so that the amount of twist or torsion is measured by taking the difference between the displacement of one pointer and the displacement of the second as read upon the two graduated arcs. Different lengths may be tested by moving the pointers along the rod. Without hanger and weights, but otherwise complete as illustrated, including two brass rods of different diameters and two steel rods of the same diameters as the brass rods..... **$30.00**



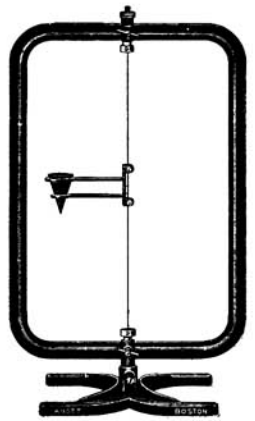
Nos. 23–50 and 23–52



No. 23–60



No. 23–90



No. 23–100

23–50 **IMPROVED SABINE'S TORSION PENDULUM** for determining the moment of torsion of a wire and the moment of inertia of a ring. The disc is 10½ inches in diameter and is attached to the wire by a small chuck fixed at its middle point. The ring has the same diameter and mass as the disc. The index dial is of cast metal with large, raised divisions and figures. Readings of torsional vibrations are obtained by direct reading of consecutive transits of the index past the zero mark or, with the addition of **No. 23–52** Mirror Attachment illustrated, by observing through a telescope the consecutive flashes from the illuminated mirror. Without mirror attachment..... **$37.50**

23–52 **MIRROR ATTACHMENT** for use on above. Attached as illustrated, over the chuck in the center of the disc..... **3.75**

23–60 **TORSION PENDULUM** for determining the moment of torsion of a steel wire and the moment of inertia of two iron weights. Suspended by a simple chuck attached to the central part of the frame. Complete as illustrated..... **18.00**

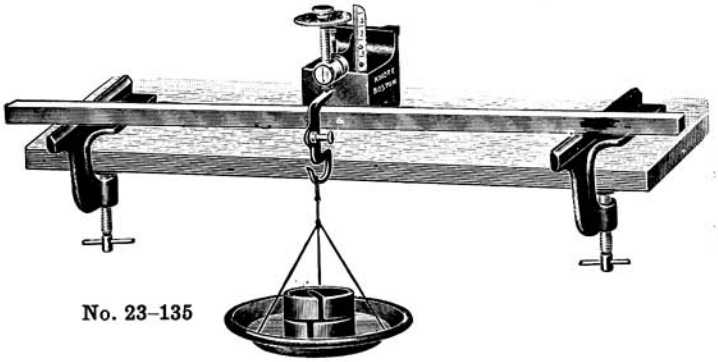
23–62 **TORSION SYSTEM** as used in above. This system is interchangeable with systems of **Nos. 23–50** or **23–100**..... **4.25**

23–90 **HARMONIC MOTION APPARATUS** for verifying the laws of harmonic motion by noting the rotational vibrations of a flat, coiled spring. Sliding weights can be adjusted to vary the inertia. Complete as illustrated..... **65.00**

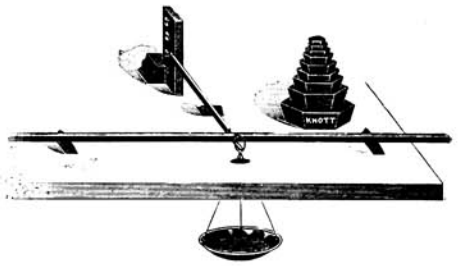
23–100 **INERTIA BALANCE** for determining the mass of a body without weighing. Simple chucks clamp the upper and lower ends of the wire. Complete as illustrated..... **17.50**

23–102 **INERTIA SYSTEM** as used in above. This system is interchangeable with systems of **Nos. 23–50** and **23–62**..... **3.75**

23–105 **RECTANGULAR CAST METAL SUPPORTING FRAME AND H-BASE,** as used in **Nos. 23–50, 23–60** and **23–100**..... **13.75**



No. 23–135



No. 23–140

23–135 **ELASTICITY OF FLEXURE APPARATUS (Contact Method)** for determining the laws for elasticity of flexure. Without weights or hanger, but otherwise complete as illustrated, including two pine rods of different cross sectional area..... **10.50**

23–138 **KNIFE EDGE CONTACT PIECE** as used in **No. 23–135.**..... **1.25**

23–140 **ELASTICITY OF FLEXURE APPARATUS (Lever Method)** for determining the laws for elasticity of flexure. Without weights, but otherwise complete as illustrated, including two pine rods of different cross sectional area..... **1.25**

23–141 **SUPPORTING TRIANGULAR PRISMS, wood.**..... Set of three **.24**

23–142 **PINE ROD, one meter long, ½×1 inch**..... **.22**

23–143 ——, ½×½ inch..... **.22**

23–144 **LEVER INDICATOR**..... **.08**

11–70 **MOUNTED 10-CM. SCALE**..... **.25**

23–146 **SCALE PAN**..... **.30**

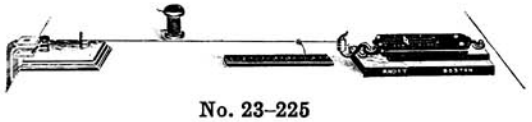
23–156 **PAIR OF WOODEN SUPPORT BLOCKS** (see Millikan, Gale & Bishop, Exp. 13)..... **1.90**

23–157 **STEEL ROD** (see Millikan, Gale & Bishop, Exp. 13)..... **.30**

No. 23–180

Nos. 23–191
and 23–192

No. 23–212



No. 23–225

23–180 **HOOKE'S LAW AND YOUNG'S MODULUS APPARATUS** for testing Hooke's Law and determining Young's Modulus for a wire. A small metal chuck is used to fasten the upper end of the wire. A metal chuck or bushing fastened to the wire is set to come within a hole in the movable casting, and moves with little play in this hole. One leg of the optical lever rests on this metal bushing, the other two rest on the ground top surface of the movable casting. A telescope and scale will be required to measure the elongation indicated by the optical lever. Complete as illustrated with six one-kilogram weights and a hanger **$35.00**

23–191 **MIRROR SCALE and UPRIGHT SUPPORT** (see Millikan, Gale & Bishop, Exp. 13) **1.75**

23–192 **SPRING AND WEIGHT HOLDER** (see Millikan, Gale & Bishop, Exp. 13) ..... **.35**

23–211 **BREAKING STRENGTH OF WIRES APPARATUS** for measuring the tensile strength of wire, metal construction throughout. We offer in this design an apparatus in which all details have been most carefully studied, worked out and tested. Rapid and accurate determinations possible even in hands of most inexperienced students. Without dynamometer **12.75**

23–212 ——, with double scale dynamometer reading to 15 kilos and 30 lbs **16.25**

23–225 **ELASTICITY OF WIRE APPARATUS** for determining the coefficient of elasticity of wire. Without spring balance or clamp, but otherwise complete as illustrated **3.15**

90–45C **SPRING BRASS WIRE No. 27** ..... Spool **.65**

23–227 **T. & H. STRETCHING BLOCK WITH PILLAR AND BINDING POST** **1.20**

23–228 **MARKER CLAMP AND STYLUS** ..... **.15**

23–231 **MOUNTED MILLIMETER SCALE** ..... **.20**

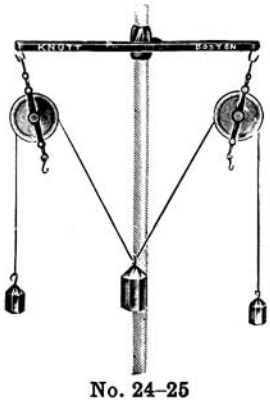
15–315 **SPRING BALANCE,** double scale, 15 kilos and 30 lbs **3.50**

15–365 **SPRING BALANCE SUPPORTING CRADLE** ..... **.95**

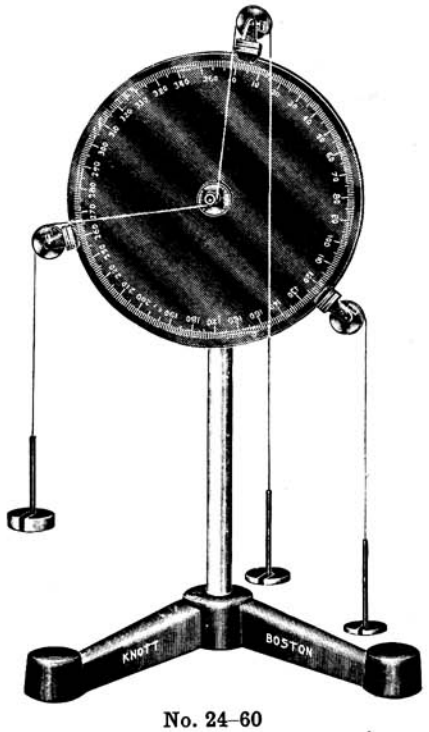
COMPOSITION OF FORCES

24–25 **COMPOSITION OF FORCE ATTACHMENT** for use on any 19-mm. rod in the study of equilibrium and composition and resolution of forces. This attachment consists of a cross head and V clamp in one casting. Hooks at ends of cross head serve to hang pulley, etc. Without illustrated pulleys, stand, or weights **$1.35**

5–600 **STONE'S TENSION CLAMPS** for holding either a string or wire firmly but adjustably. Originally designed for the study of composition and resolution of forces, yet of exceptional value in clamping a string or wire for any purpose ..... Each **.90**



No. 24–25



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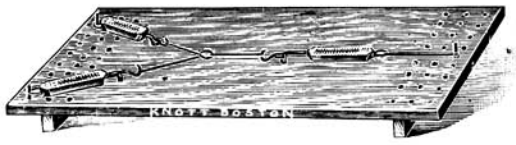


No. 24–80

24–60 PARALLELOGRAM OF FORCE TABLE, adjustable to horizontal or vertical position on 60 cm. rod, for use in determining laws of composition and resolution of forces. Constructed of metal throughout, and all parts massive in design to insure stability. The table is 35 cm. in diameter, is turned smooth, graduated into degree divisions, and nickel-plated. The pulleys are of brass, mounted in frictionless bearings. The centering arrangement is simple in design, but effective in insuring accurate results. Complete with three pulleys, weights and weight hangers. Tripod supplied with leveling screws (not illustrated) **$62.50**

24–61 ——, on 100 cm. rod **63.50**

24–80 COMPOSITION OF FORCE BOARD (See Millikan, Gale & Bishop, Exp. 11). Without balances, but with three pegs to fit the holes in the board **4.00**

24–87 COMPOSITION OF FORCE BOARD, ordinary form for use on four balls. With four balls and four pegs to fit the holes in the board **3.40**

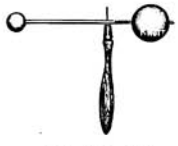
24–95 WIRE PENTAGON (See National Physics Direction Sheets, Exp. M274) ..... **.35**

FORCE OF GRAVITATION

Equilibrium — Stable, Unstable and Neutral

No. 25–10

No. 25–15



No. 25–20

No. 25–50

No. 25–55

No. 25–75

25–10 CENTER OF GRAVITY BOARD for determining the center of gravity of an irregularly shaped board. Complete with handle and plumb bob **$1.75**

25–15 CENTER OF GRAVITY ARC for illustrating stable and unstable equilibrium. The balanced system is so designed that the center of gravity can be changed to demonstrate stable, unstable and neutral equilibrium. Complete with stand **3.25**

25–20 CENTER OF GRAVITY SYSTEM for illustrating center of gravity. The rod has two holes — one at geometric center, the other at the center of gravity. Complete as illustrated **1.40**

25–50 LOADED CYLINDER WHEEL for illustrating the center of gravity of a loaded wheel. Two holes are drilled in the wheel — one at the geometric center, and one off center. A weight is attached at one side so that its position can be adjusted to bring the center of gravity at the hole drilled off center. Complete with support **2.95**

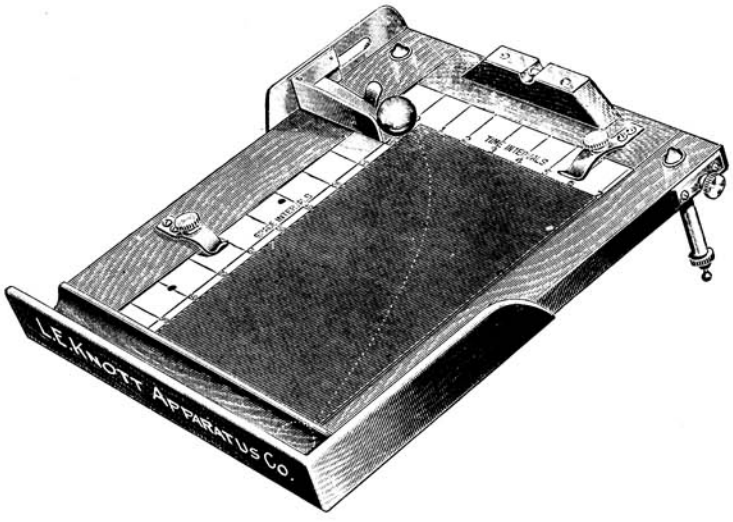
25–55 LOADED CYLINDER illustrating the tendency of a body to place its center of gravity as low as possible. The cylinder is loaded eccentrically and if rolled along a horizontal surface, will come to rest on its loaded side ..... **.45**

25–60 WITCH, illustrating the tendency of a body to keep its center of gravity as low as possible — a short piece of pith at one end of which is a loaded hemispherical piece of metal ..... **.18**

25–75 LEANING TOWER illustrating stability when a line drawn through the center of gravity comes within the base of support. Top and foot removable **3.25**

FALLING BODIES

ACCELERATED MOTION



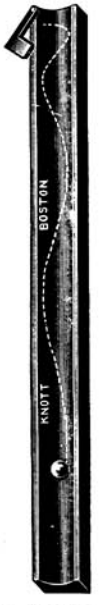
No. 25–100

25–100 **PACKARD'S FALLING BODY APPARATUS** for the determination of the laws of accelerated motion with their application to falling bodies, the data being obtained from the path that the falling body traces during descent. The falling body, a steel sphere, rolls down over the smooth surface of a sheet of paper covered with a soft carbon tracing paper, and leaves a permanent record. With 12 sheets cross-section and 2 sheets carbon paper and complete directions **$12.75**
(Special circular on request.)

25–101 **CROSS SECTION PAPER,** special ruled..... Per 10 sheets **.45**

25–102 **CARBON PAPER,** as used in **No. 25–100.**..... Sheet **.14**

25–105 **DUFF'S ACCELERATION APPARATUS** for determining the acceleration of a falling body. The apparatus consists of an accurately-grooved plank. With the plank placed horizontally on the table, a steel ball placed on one end of the groove will, when released, oscillate back and forth like a pendulum and the time of each swing will remain constant. If, however, one end of the plank be raised a little higher than the other, a ball placed in the middle of the groove will roll down with accelerated motion. By combining the oscillatory motion across the groove with the accelerated motion down the incline, the oscillatory motion may be made to trace in a film of lycopodium powder equal intervals of time for the study of accelerated motion. Grooved plank complete with sphere, releasing block and package of lycopodium powder..... **8.00**



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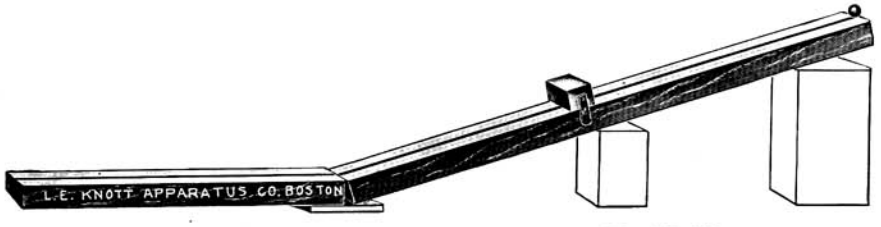
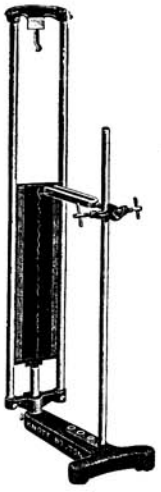


No. 25–112 No. 25–110

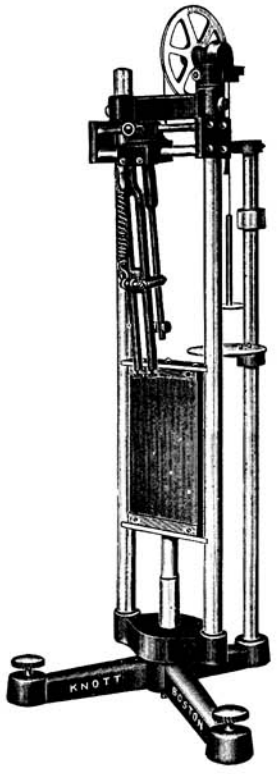
25–110 **FALLING BODY APPARATUS (16-foot Inclined Plane),** (see Millikan & Gale's "A First Course in Physics," page 26) for determining the distance traversed by a body in one, two, three and four seconds under uniformly accelerated motion. The track for the falling body (a steel sphere), is a most accurately cut V-groove. With steel sphere and block stop..... **17.50**

25–112 **FALLING BODY APPARATUS (8-foot Inclined Plane),** for use with above for measuring the velocity acquired per second by a body under force of gravity in uniformly accelerated motion... **8.00**

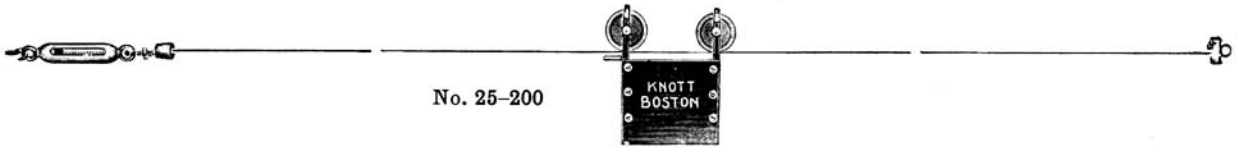


No. 25–140

No. 25–120



No. 25–162



No. 25–200

25–120 FOUR-FOOT FREE FALL DEMONSTRATION APPARATUS or **GUINEA AND FEATHER TUBE** for demonstrating that all bodies, even if of different masses, fall in equal intervals of time if released from friction of air pressure. Complete as illustrated **$14.50**

25–140 IMPROVED ALL-METAL FALLING BODY APPARATUS for determining the velocity and acceleration of a freely falling body. The falling body is a glass plate mounted in a frame which slides freely between the vertical uprights. A dash pot at base takes up the jar and prevents a rebound. The clamp will hold any tuning fork and is adjustable along the rod. Without tuning fork..... **16.75**

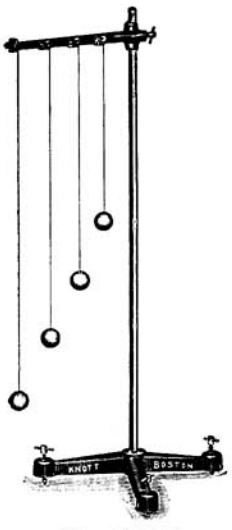
25–162 ACCELERATION APPARATUS WITH ELECTRICALLY DRIVEN TUNING FORK for determining the acceleration of a falling body moving with uniformly accelerated motion. The falling body is the carriage and electrically operated tuning fork which slides freely between the vertical uprights. A light metal stylus attached to one of the prongs of the tuning fork records the vibrations on the smoked glass plate while the carriage is falling. Full directions for setting up and adjusting the apparatus, for reading and interpreting the tracing, and suggestions regarding the experiments for which the apparatus is adapted, are included with each apparatus.
The Atwood's Attachment consists of a carefully balanced aluminum wheel in ball bearings, counterbalance weight, extra weights for use as riders and an adjustable platform. Complete as illustrated. **90.00**

25–168 EXTRA GLASS PLATES for above. ..... Each **.45**

25–200 UNIFORMLY ACCELERATED MOTION APPARATUS for the study of principles of accelerated motion and for determining factors governing a body under uniformly accelerated motion. The falling body is the car whose free fall is retarded by rolling down a wire stretched taut at a slight incline. Complete as illustrated..... **6.80**

25–201 LYON'S CAR WITH BUFFER as used in above..... **3.60**

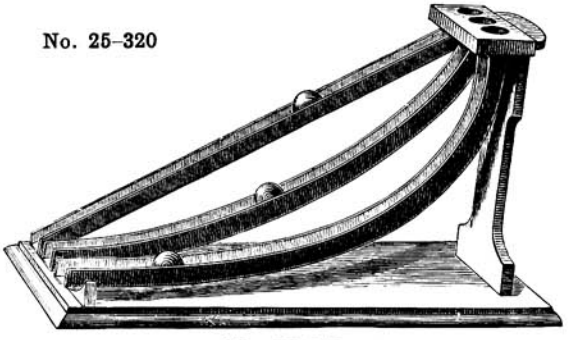
25–202 INCLINED WIRE OUTFIT, wire, screw, hook and turn-buckle as used in above..... **3.20**



No. 25–225

No. 25–251

No. 25–320



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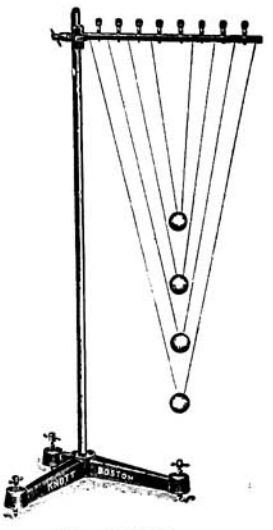
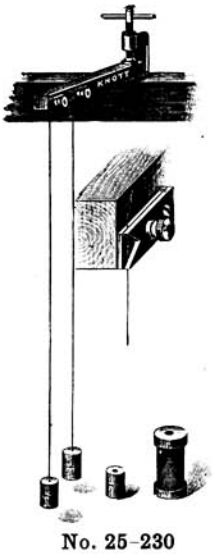


No. 25–235



No. 25–230

25–225 **FOUR-BALL PENDULUM ILLUSTRATION** for determining factors governing the laws of pendulums. Pendulum Clamp **No. 5–900** with four balls, with suspensions ready for attachment to a stand. Without stand. **$6.25**

25–227 **THREE-BALL PENDULUM ILLUSTRATION.** Pendulum Clamp **No. 5–902** with three balls, with suspensions ready for attachment to stand. Without stand **4.45**

25–230 **PENDULUM APPARATUS** (see National Physics Direction Sheets, Exp. M340). Pendulum Clamp with suspension wire and three special cylindrical pendulum bobs. Without the illustrated iron clamp **2.90**

25–230a **PENDULUM CLAMP** as used in above ..... **.95**

25–230b **SPECIAL CYLINDRICAL IRON BOB** as used in **No. 25–230** above ..... **.45**

25–230c **SPECIAL CYLINDRICAL LEAD BOB** as used in **No. 25–230** above ..... **.45**

25–230d **SPECIAL CYLINDRICAL BRASS BOB** as used in **No. 25–230** above ..... **.55**

90–10i **COPPER WIRE** No. 30 B. & S. Gauge, as used in **No. 25–230** above. ..... 4-oz. spool **.50**

25–232 **SIMPLE AND REVERSIBLE PENDULUM APPARATUS** (see Hall, No. XLIV). Complete with bobs but without meter stick **7.25**

25–235 **FOUR-BALL BI-FILAR SUSPENDED PENDULUM ILLUSTRATION.** Pendulum Clamp **No. 5–905** with four balls with suspensions ready for attachment to a stand. Without stand **7.80**

No. 25–260

25–251 **CULLER'S ADJUSTABLE LEVER, PULLEY AND PENDULUM CLASP AND HOOK ROD** (see Culler's "Laboratory Manual of Physics," Exps. VII, X and XI). A most comprehensive design, useful for many experiments. Without clamp **4.50**

25–260 **REVERSIBLE PENDULUM** for determination of center of suspension and center of oscillation, and, by measurement of the distance between these centers, to determine the length of the equivalent simple pendulum, and from this, the value of the acceleration of gravity. Complete with stirrup and bracket as illustrated. **6.50**

25–310 **SWIFTEST DESCENT APPARATUS,** comparing descents of spheres of the same diameter along inclines of different curvatures. The apparatus consists of three tracks placed on an incline to the base line — one track describing a cycloid curve, the second a concave circular curve, the third an inclined plane. The apparatus is further provided with a device for the simultaneous start of all three spheres. The singular results follow a simultaneous start of all three spheres — the sphere on cycloidal curve reaches end of track first, on concave circular track second, while the one on the inclined track is the slowest. One other striking experiment will be noted — no matter from which point on the cycloidal track the sphere is started, the time of descent to the end of the track will always be the same. Complete with three steel spheres **21.25**

25–320 **DOUBLE CONE AND PLANE** for illustrating the seemingly paradoxical phenomenon of a cone moving up an incline, which is of such shape that its axis actually descends **4.00**

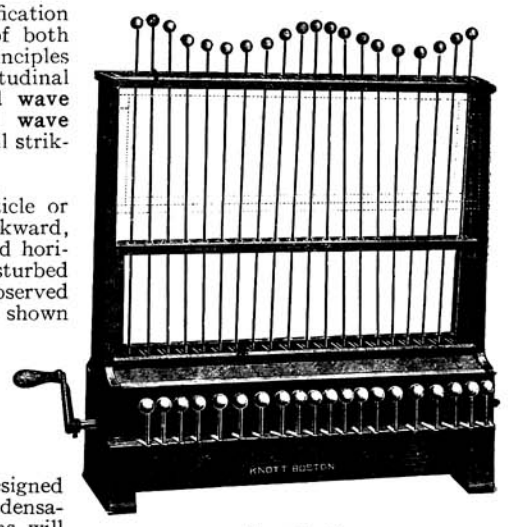
WAVE MOTION

26–10 UNIVERSAL WAVE MOTION APPARATUS, modification of Powell's and Snell's designs, combining features of both into one instrument capable of demonstrating all principles of each. Thus the combination transverse and longitudinal component illustrating **waves on surface of a liquid wave motion as set up by transverse displacements,** and **wave motion as set up by longitudinal displacements** are all strikingly shown.

WATER WAVES. In our model we show that the particle or element on the crest moves forward, in the trough backward, and in the intermediate positions both vertically and horizontally. The elliptical or circular orbits of the disturbed particles are ample in size that they may be readily observed by all even in the largest lecture hall. It may also be shown that the wave form is not a sine curve.

TRANSVERSE WAVE FORM. The demonstration of movement of a particle transversely and the transverse wave form as well as the analysis of the resultant sine curve is especially adapted to this model.

LONGITUDINAL WAVE FORM. Our model is so designed that in demonstrating any of the above forms the condensations and rarefactions set up by longitudinal vibrations will also be formed, thus affording a striking comparison of wave forms.



No. 26-10

This model stands about three feet high and all parts are so proportioned that it is especially adapted for lecture purposes. The elements are represented by balls; vibrations, transverse or longitudinal, are communicated by brass rods; and the vibrations are set up in the rods by means of peculiarly cam-shaped castings eccentrically mounted, each rod to its own casting, and all on a shaft operated by a single crank. When the rectangular guide frame is in the position illustrated both transverse and longitudinal wave motions are demonstrated. With the guide frame in position as indicated by dotted lines, water waves and longitudinal waves are demonstrated.

This apparatus is carefully assembled and all parts accurately made. All woodwork is neatly finished and the whole presents a scientific and handsome appearance..... **$145.00**

No. 26–40

26–20 WAVE APPARATUS for illustrating the formation of transverse and longitudinal waves. The steel ribbon is about 13 feet long; cross heads are fixed at regular intervals (5 inches). At each end of each cross head is a metal ball. Balls on either side of ribbon are painted a distinguishable color. A longitudinal or transverse motion applied to one cross head is communicated to the other cross heads until the balls are describing longitudinal or transverse wave forms..... **$16.50**

26–29 SPIRAL SPRING for illustrating wave motion. A close spiral of brass wire, 6 ft. long..... **3.00**

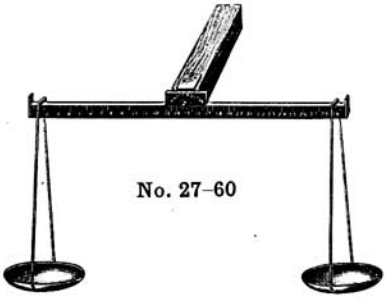
26–40 FIVE-FOOT METAL-FRAME WAVE TROUGH for illustrating water waves. The ends and bottom are metal castings to which the glass sides are sealed water-tight. The water line is drawn accurately parallel to the base. With paddle for forming waves..... **45.00**

No. 26-20

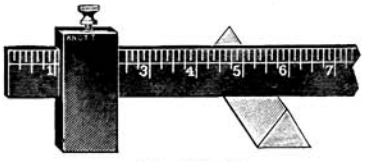
SIMPLE MACHINES

No. 27–30

No. 27–45
(Showing Lever of the First Class)



No. 27–60



No. 27–77

No. 27–45

27–10 **COEFFICIENT OF FRICTION APPARATUS** for the study and determination of the coefficient of friction. A planed white wood board, 50×20 cms. and a block of wood with face 7.5 cms. square. With Spring Dynamometer **$2.50**

27–11 **WHITE WOOD BOARD,** 50×20 cms. ..... **.90**

27–12 **WOOD BLOCK,** face 7.5 cms. square ..... **.15**

27–30 **DEMONSTRATION LEVER WITH METAL INDEX POINTER.** The metal index pointer clamps over the central knife edge. Without meter stick, but otherwise complete as illustrated, including two Lever Clamps No. 27–45, and cast metal base **2.85**

27–45 **KITTREDGE LEVER CLAMPS** for use with a meter stick in study of levers, composition of forces, etc. Per set of three **1.20**

27–60 **LEVER APPARATUS** for study of mechanical advantage of a lever. Complete as illustrated with scale pans with improved knife edge bearings (No. 27–62) **1.80**

27–61 **LEVER AND SUPPORTING BAR** only ..... **.90**

27–61a **STRAIGHT LEVER** only ..... **.55**

27–61b **SUPPORTING BAR AND PIVOT** ..... **.35**

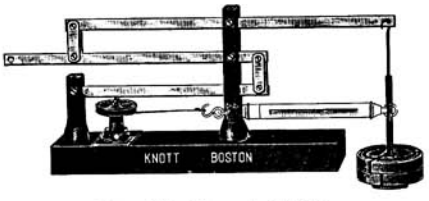
27–62 **RICE'S SCALE PANS** with **Improved Knife Edge Bearings**. ..... Pair **.90**

27–67 **SCALÆ PANS** with attached strings, each adjusted to weigh 1 ounce. ..... Pair **.75**

27–75 **RIDER-BLOCK** (see Hall and Bergen, Exp. 12), for use on meter stick in determining weight of lever arms ..... **.30**

27–77 **RIDER WEIGHT, lead** (see National Physics Direction Sheets). Fits over standard meter stick to determine weight of lever arm **1.15**

27–80 **U-SHAPED WIRE SUPPORTING HOOK** (see National Physics Direction Sheets, Exp. M130). **.12**



Nos. 27–96 and 27–97

27–95 **COMPOUND LEVER** illustrating a combination of simple levers to secure power equivalent to a simple lever with long power arm. Brass arms suitably mounted on a wooden base **8.00**

27–96 **LARGE SIZE COMPOUND LEVER** for practical demonstration of mechanical advantage of a compound lever. By the addition of No. 27–97 Jack Screw Attachment (illustrated on base of lever) the combined mechanical advantage of a Compound Lever and Jack Screw can be determined. Without Jack Screw, Weights or Dynamometer **17.50**

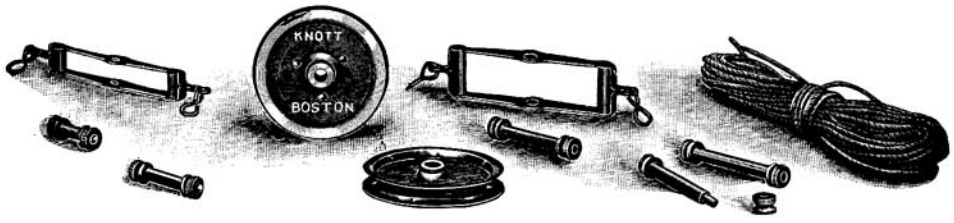
27–97 **JACK SCREW ATTACHMENT,** a commercial type Jack screw, mounted for use with Compound Lever No. 27–96 as illustrated **3.50**

27–100 **STEELYARD,** capacity 50 pounds **1.25**

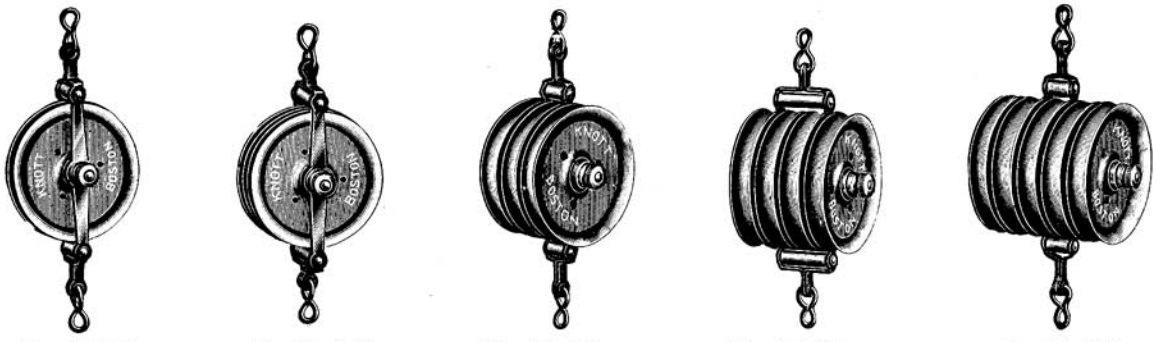
PULLEYS

27–125 **SINGLE PULLEY, new form,** pressed steel, 5 cms. in diameter, mounted on axle in stirrup, for use as either a fixed or movable pulley..... **$0.35**
27–126 **DOUBLE PULLEY,** same construction as above..... **.60**
27–127 **TRIPLE PULLEY,** same construction as above..... **.90**
27–128 **QUADRUPLE PULLEY,** same construction as above..... **1.25**

HARCOURT BALL-BEARING FRICTIONLESS PULLEYS



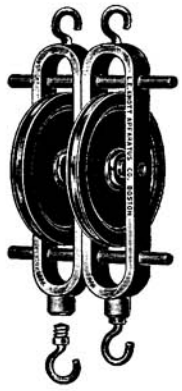
Illustrating Unit Parts to Assemble as Pictured Below



No. 27–150 **No. 27–152** **No. 27–154** **No. 27–156** **No. 27–158**

In many of the pulley experiments as conducted in laboratories today, the student cannot justly be blamed for the inaccuracies of his conclusions. A pulley should run true and free of friction. The advantage of our design is that, starting with the Basic Pulley Unit, by the addition of proper stirrups and axle rods, an equipment of Frictionless Pulleys can be purchased at a cost but slightly in excess of the inexpensive types without ball bearings.

27–165 **BALL-BEARING BASIC PULLEY UNIT.** This pulley consists of two parts, each stamped out of one piece of steel and riveted together with ball race in place..... **$0.50**
27–167 **SINGLE PULLEY AXLE ROD.** With **Nos. 27–165** and **27–177,** forms a single pulley..... **.20**
27–169 **DOUBLE PULLEY AXLE ROD.** With 2 **No. 27–165** and **No. 27–179,** forms a double pulley.... **.20**
27–171 **TRIPLE PULLEY AXLE ROD.** With 3 **No. 27–165** and **No. 27–177,** forms a triple pulley..... **.20**
27–173 **QUADRUPLE PULLEY AXLE ROD.** With 4 **No. 27–165** and **No. 27–179,** forms a quadruple pulley..... **.20**
27–175 **QUINTUPLE PULLEY AXLE ROD.** With 5 **No. 27–165** and **No. 27–177,** forms a quintuple pulley..... **.20**
27–177 **SINGLE WIDTH STIRRUP.** Required in assembling a single, triple or quintuple pulley..... **.25**
27–179 **DOUBLE WIDTH STIRRUP.** Required in assembling a double or quadruple pulley..... **.30**
27–140 **FOUR PULLEY UNIT ASSORTMENT.** Four Basic Pulley Units with Axle Rods and Stirrups to assemble **either** of the following combinations:
4 **Single Pulleys** 2 **Double Pulleys** Set..... **4.75**
27–141 **SIX PULLEY UNIT ASSORTMENT.** Six Basic Pulley Units with Axle Rods and Stirrups to assemble **any** of the following combinations:
6 **Single Pulleys** 3 **Double Pulleys** 2 **Triple Pulleys** Set..... **7.50**
27–142 **EIGHT PULLEY UNIT ASSORTMENT.** Eight Basic Pulley Units with Axle Rods and Stirrups to assemble **any** of the following combinations:
8 **Single Pulleys** 4 **Double Pulleys** 2 **Triple Pulleys** 2 **Quadruple Pulleys** Set..... **10.25**
27–143 **TWELVE PULLEY UNIT ASSORTMENT.** Twelve Basic Pulley Units with Axle Rods and Stirrups to assemble **any** of the following combinations:
12 **Single Pulleys** 6 **Double Pulleys** 4 **Triple Pulleys** 3 **Quadruple Pulleys** 2 **Quintuple Pulleys** Set.. **16.00**
27–150 **SINGLE BALL-BEARING PULLEY, Nos. 27–165, 27–167** and **27–177** assembled..... **.95**
27–152 **DOUBLE BALL-BEARING PULLEY, Nos. 27–165** (2), **27–169** and **27–179** assembled..... **1.50**
27–154 **TRIPLE BALL-BEARING PULLEY, Nos. 27–165** (3), **27–171** and **27–177** assembled..... **1.95**
27–156 **QUADRUPLE BALL-BEARING PULLEY, Nos. 27–165** (4), **27–173** and **27–179** assembled..... **2.50**
27–158 **QUINTUPLE BALL-BEARING PULLEY, Nos. 27–165** (5), **27–175** and **27–177** assembled..... **2.95**
27–185 **PULLEY CORD,** extra quality, $\frac{1}{16}$-inch diameter, selected especially for pulley experiments. Per hank of five yards..... **.25**



No. 27–200

No. 27–216

No. 27–230a

No. 27–230b

No. 27–230c

27–200 **LATHE TURNED FRICTIONLESS PULLEY,** brass pulley wheel 2½ inches in diameter, centered in lathe and turned all over, square groove. Stirrups designed so that one hook can be unscrewed and the pulley used with any rod threaded ¼×20 (10-mm. rod). Combinations as illustrated are possible by use of a pair of steel rods.....Each pulley **$7.00**

27–201 **STEEL RODS** for use in making combinations as illustrated above.....Pair **.20**

27–216 **TRIPLE TANDEM PULLEYS.** Three free running pulley wheels of different diameters mounted in a metal frame..... **2.70**

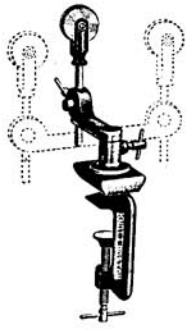
27–230a **SINGLE TACKLE BLOCK.** A commercial block with self-lubricating iron bushing. Each shell with swivel hook and becket. Shell, 4 inches; sheave, 2¼×⅝×⅜ inches. Requires rope ⅜ inch diameter..... **3.30**

27–230b **DOUBLE TACKLE BLOCK,** same construction as above, but two sheaves..... **4.65**

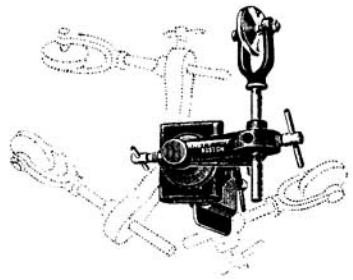
27–230c **TRIPLE TACKLE BLOCK,** same construction as above, but three sheaves..... **6.30**

27–235 **MANILA CORDAGE,** ⅜-inch diameter, best quality manila hemp. Sold only in multiples of 10 feet.....Per 10 feet **.75**

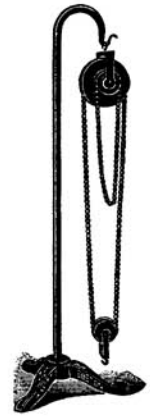
No. 27–240



(Front view)



No. 27–252 (Top view)

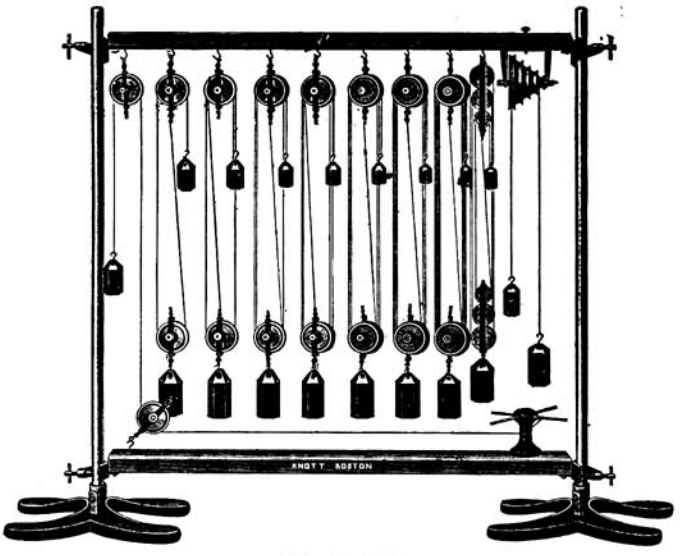


No. 27–242

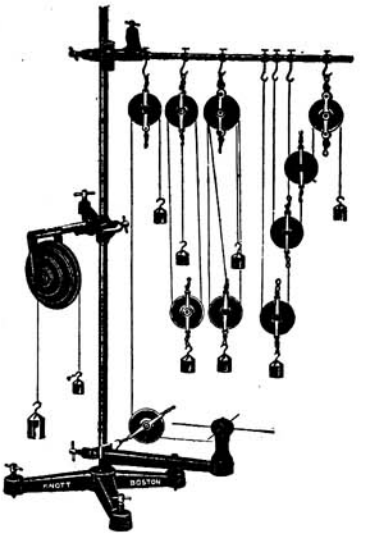
27–240 **COMMERCIAL ¼-TON DIFFERENTIAL PULLEY HOIST** for demonstration of mechanical advantage of a commercial pulley hoist. Regular hoist, 6 feet, minimum distance between hooks, 17 inches; weight, 22 lbs., capacity, ¼ ton; chain pull 72 lbs. through 18 feet..... **22.50**

27–242 **DIFFERENTIAL PULLEY HOIST MODEL,** brass pulleys. Complete with stand..... **9.00**

27–252 **UNIVERSAL PULLEY WITH SWIVEL ARM.** Lathe-turned brass pulley in stirrup on a rod. This rod is adjustable to six different positions on arm swiveled to the clamp..... **4.25**



No. 27–276



No. 27–285

27–275 PULLEY DEMONSTRATION APPARATUS for demonstration of pulleys and the application of principles thereof to wheels and axles and capstans. With the exception of the weights, the apparatus is furnished complete for assembling all of the combinations illustrated, but in the case of the pulley combination it is not possible to set up all of the combinations together as a permanent exhibit. For a **permanent exhibit** showing all combinations as illustrated at one time, see **No. 27–276.** For pulley equipment we furnish ball-bearing basic pulley units and accessory axle rods and stirrups as follows:

10 Ball-Bearing Basic Pulley Units,	**No. 27–165**	2 Quadruple Pulley Axle Rods,	**No. 27–173**
2 Single Pulley Axle Rods,	**No. 27–167**	2 Quintuple Pulley Axle Rods,	**No. 27–175**
2 Double Pulley Axle Rods,	**No. 27–169**	2 Single Width Stirrups,	**No. 27–177**
2 Triple Pulley Axle Rods,	**No. 27–171**	2 Double Width Stirrups,	**No. 27–179**

In addition to the pulley units we furnish the Stands, Metal Uprights, Wood Cross Bars with Metal Clamps, Aluminum Five Diameter Wheel and Axle, Capstan and Lever and 2 Triple Tandem Pulleys..... **$45.75**

No. 27–325

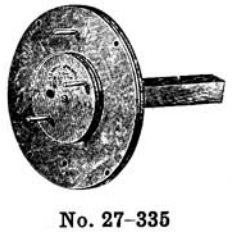
27–276 PULLEY DEMONSTRATION APPARATUS for a permanent exhibit of all pulley combinations illustrated—weight and power as 1:2, 1:3, 1:4, 1:5, 1:6, 1:8 and 1:10, including Stands, Metal Uprights, Wood Cross Bars with Metal Clamps, Aluminum Five-Diameter Wheel and Axle, Capstan and Lever, 2 Triple Tandem Pulleys and Ball-Bearing Pulleys as follows: 5 **No. 27–150** Single, 4 **No. 27–152** Double, 3 **No. 27–154** Triple, 2 **No. 27–156** Quadruple, and 2 **No. 27–158** Quintuple, with all necessary weights..... **73.50**

27–285 PULLEY STUDY APPARATUS consists of **No. 22–131** Stand and Support Rod, 2 **No. 5–770** Right Angle Clamps, 4 Hook Collars **No. 5–645, No. 5–10d** Support Rod, 4 **No. 27–150** Ball-Bearing Single Pulleys, 2 **No. 27–152** Ball-Bearing Double Pulleys, **No. 27–325** Wheel and Axle, and **No. 27–290** Capstan Arm and Capstan, but without weights..... **34.00**

27–290 CAPSTAN ARM AND CAPSTAN, clamp and capstan arm cast as one piece of metal..... **5.25**

27–305 WOODEN STRIP WITH TWO HOOKS (see National Physics Direction Sheets, Exp. M320).. **.25**

27–325 ALUMINUM FIVE-DIAMETER WHEEL AND AXLE for attachment to support rod by means of a clamp, in determining the mechanical advantage of a wheel and axle. Mounted in cone-bearing in a metal frame cast with the rod as one piece of metal. The aluminum wheel is finished to diameters having simple ratios: 1:2:6:8:10. Without clamp or support rod..... **5.25**



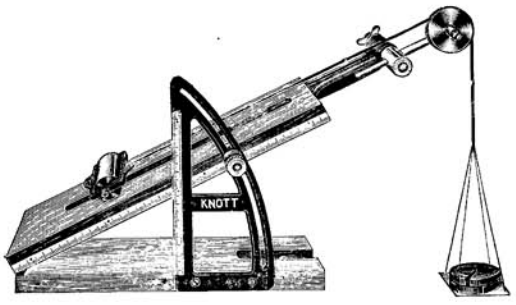
No. 27–335

27–335 WHEEL AND AXLE (see Hall & Bergen's "A Text-Book of Physics," Par. 64). Designed to show that the wheel and axle is a modified lever of first class. With three brass pins to fit the holes drilled in the disc..... **3.25**

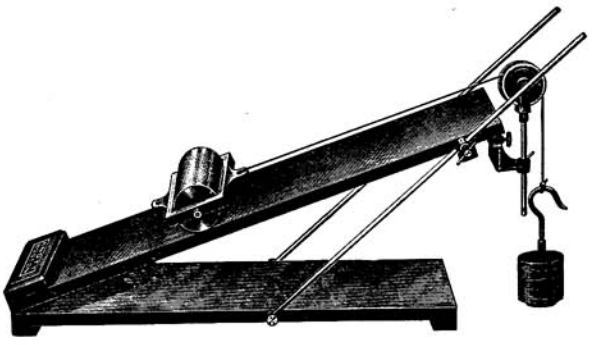
No. 27–435

No. 27–440

No. 27–393



No. 27–402



No. 27–410

27–390 **HALL'S IMPROVED INCLINED PLANE WITH SIDE RAILS AND SCREW ADJUSTMENT,** 120 cms. long by 15 cms. wide. Screw adjustment for comparison of masses by acceleration test. (See Hall & Bergen's "A Text-Book in Physics," Ex. 36) **$4.25**

27–392 **POLISHED HARDWOOD INCLINED PLANE** (see Millikan, Gale & Bishop, Exp. 17) **2.95**

27–393 **BALL-BEARING PULLEY IN FRAME** for use with **No. 27–392** Inclined Plane or for attachment to any board or table top not over 1¼ inches thick **1.80**

27–394 **SONOMETER ATTACHMENT** for use with **No. 27–392** Inclined Plane in making a simple sonometer (see Millikan, Gale & Bishop, Exp. 41) ..... **.60**

27–400 **HALL'S INCLINED PLANE APPARATUS** for determining the mechanical advantage of an inclined plane. Polished hardwood, with graduated scales for both incline and height. Without scale pan, roller and weights **8.75**

27–402 ——, with scale pan and **No. 27–405** Roller, but without weights **11.75**

27–405 **ONE-POUND INCLINED PLANE ROLLER** for use as a mass of known weight in inclined plane experiments. The roller is accurately turned, centered and mounted on cone-bearings in a metal frame, the whole mass adjusted to weigh exactly one pound **2.75**

27–410 **PRATT INSTITUTE INCLINED PLANE,** large size to carry an appreciable weight. Variations in incline are secured by the swiveled rods which may be clamped in any desired position. The pulley wheel has ball bearings. The weight illustrated is **No. 27–412** Roller. Without weights, hanger, or roller **14.50**

27–412 **PRATT INSTITUTE ELEVEN-POUND INCLINED PLANE ROLLER** for use as a mass of known weight in inclined plane experiments. The roller is accurately turned, centered and mounted in pivotal bearings in the cast metal frame — the whole adjusted to weigh 11 lbs. **8.25**

27–435 **THREE-WHEEL INCLINED PLANE CAR.** A car with positive wheel action on all wheels. The body and stirrups for wheels are cast in one piece of metal; the wheels are accurately turned and are mounted on cone bearings **3.95**

27–440 **FOUR-WHEEL INCLINED PLANE CAR,** four wheels mounted on pivotal bearings but stirrups so designed that all four wheels rest in same plane **2.85**

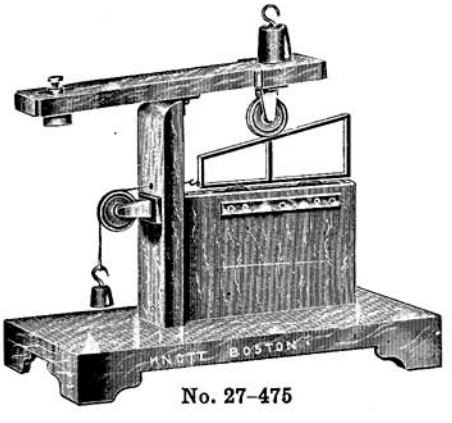
27–460 **WOODEN SPREADER.** When there is no slot lengthwise of inclined plane, this spreader will be found of great convenience in applying power parallel to the base of the plane ..... **.24**

27–465 **RUBBER CORD** for use with an inclined plane car in inertia experiments (see Hall & Bergen's "A Text-Book of Physics," Ex. 36) ..... **.25**

27–475 **MODEL OF WEDGE** for determining the mechanical advantage of a wedge. This apparatus consists of a wedge-shaped metal skeleton which in operation is held between three easily-running pulley wheels supported above and below the wedge. "Power" is attached by means of a cord over the fourth pulley illustrated. "Weight" is supported from above on hinged platform. Without weights **12.50**

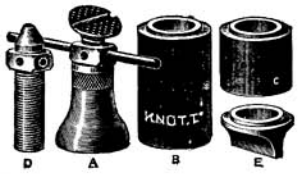
WEIGHTS. See Section 16.

27–485 **WEDGE.** A two-part piece of hardwood, 18 cms. long, each part 2½ cms. at point of greatest thickness ..... **.75**



No. 27–475

No. 27–500



No. 27–510

No. 27–520

27–500 **MODEL OF A SCREW** for qualitative illustration of the great mechanical advantage of a screw. A piece of wood placed across the metal breaking wedge can easily be broken by turning the screw **$3.90**

27–510 **JACK SCREW AND ACCESSORIES** for demonstrating the mechanical advantage of a jack screw; used also for leveling purposes. The base is 1¼ inches in diameter and is adjustable from 2¼ to 3⅝ inches in height. By use of Extension Bases " B " and " C " a range from 2¼ to 6½ inches is possible. The Extension Screw " D " is interchangeable with the screw with swivel cap. The auxiliary Base " E " is oftentimes necessary. Complete **2.25**

27–510A **JACK SCREW** only of above, " A " in illustration **1.20**

27–510B **EXTENSION BASE,** 2 inches high, " B " in illustration ..... **.35**

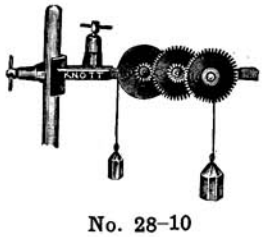
27–510C ——, 1 inch high, "C" in illustration ..... **.30**

27–510D **EXTENSION SCREW,** " D " in illustration ..... **.25**

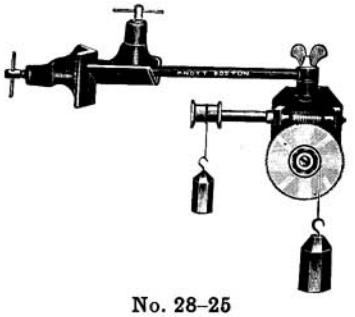
27–510E **EXTENSION BASE,** " E " in illustration ..... **.25**

27–520 **FIVE-TON ROLLER-BEARING COMMERCIAL JACK SCREW.** Screw $1\frac{3}{16}$ inches diameter, with square cut threads and provided with roller bearings. Range 9 to 15 inches **5.80**

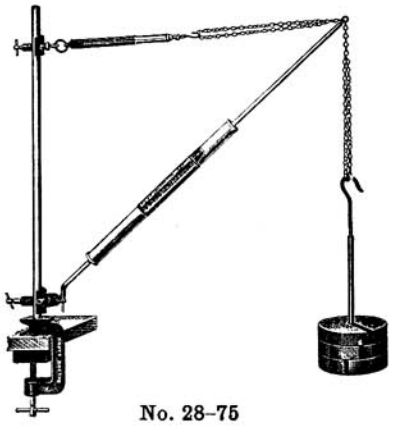
COMPLEX MACHINES



No. 28–10



No. 28–25



No. 28–75

28–10 **SIMPLE GEARED WHEELS** illustrating the mechanical advantage of a system of geared wheels. Two wheels with pinions ¼ the diameter of the wheels; a third has a drum of the same ratio, thus giving a mechanical advantage of 1:64. Without clamp or supporting rod **$6.50**

28–25 **ENDLESS SCREW** for determining the mechanical advantage of a gear operated by a screw. Mounted on a casting and attached to the rod by a swivel joint which may be held fixed by the thumb nut. Without clamp **9.50**

28–75 **CRANE DEMONSTRATION APPARATUS** for quantitative demonstration of boom stress and guy strains in cranes. Boom designed with spring to register in metric and English systems up to 30 lbs. Boom with attached chain, but without any of the accessory apparatus listed below. **12.00**

Accessory Apparatus for No. 28–75

28–78 **THREADED HOOK,** threaded ¼×20, for use with **No. 5–785** Right Angle Clamp with which it is shown illustrated ..... **.30**

15–332 **SPRING DYNAMOMETER,** registering 20 lbs. by ¼ lb. **3.30**

5–360 **TABLE CLAMP** **3.00**

5–730 **RIGHT ANGLE CLAMP** **1.45**

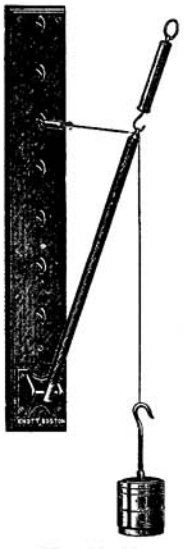
5–785 **RIGHT ANGLE CLAMP** **1.10**

5–20e **SUPPORT ROD,** 100 cms. long, 19 mm. diameter **2.20**

28–79 **CRANE BOOM** (see Fuller & Brownlee, Exp. 24) ..... **.40**

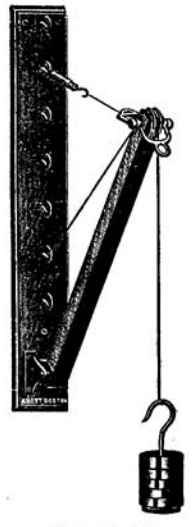
PRATT INSTITUTE APPLIED PHYSICS APPARATUS

While some of the apparatus listed under this heading suggests types common in laboratory work, it will be noted that there is an essential difference, *viz.*, size. All designs are made on a *large scale* for a definite pedagogic reason — the educational value of muscular reaction serving as the keynote of this work in Applied Mechanics.



No. 29–60

No. 29-30



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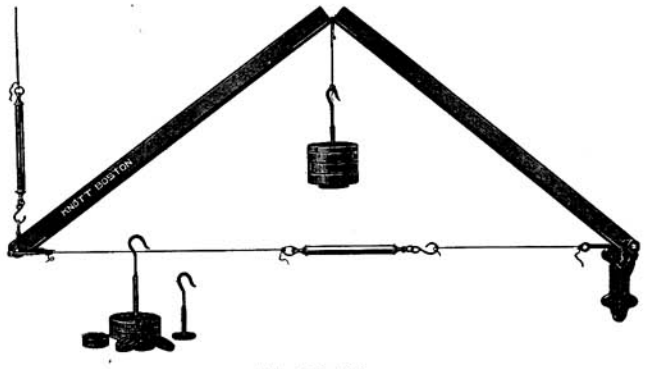


No. 29-100

27–410 **PRATT INSTITUTE INCLINED PLANE.** See listing, page 57 ..... **$14.50**

27–412 **PRATT INSTITUTE INCLINED PLANE ROLLER.** See listing, page 57 ..... **8.25**

27–435 **PRATT INSTITUTE INCLINED PLANE CAR.** See listing, page 57 ..... **3.95**

29–30 **SHEAR LEGS.** A most impressive illustration of the composition of forces as applied to the shear legs, solving definitely, 1st, the tension in the tie; 2d, the compression in the legs of shears; and 3d, the forces necessary to keep the legs from spreading. Legs of seamless tubing. Without balances, weights and hanger **12.75**

29–60 **SIMPLE TRUSS** for showing forces in the simple stick and tie. Without balances, weights and hanger **4.50**

29–80 **SMALL HOISTING CRANE** for determining both tension and compression in the hoisting crane. Without balance, weights and hanger **6.75**

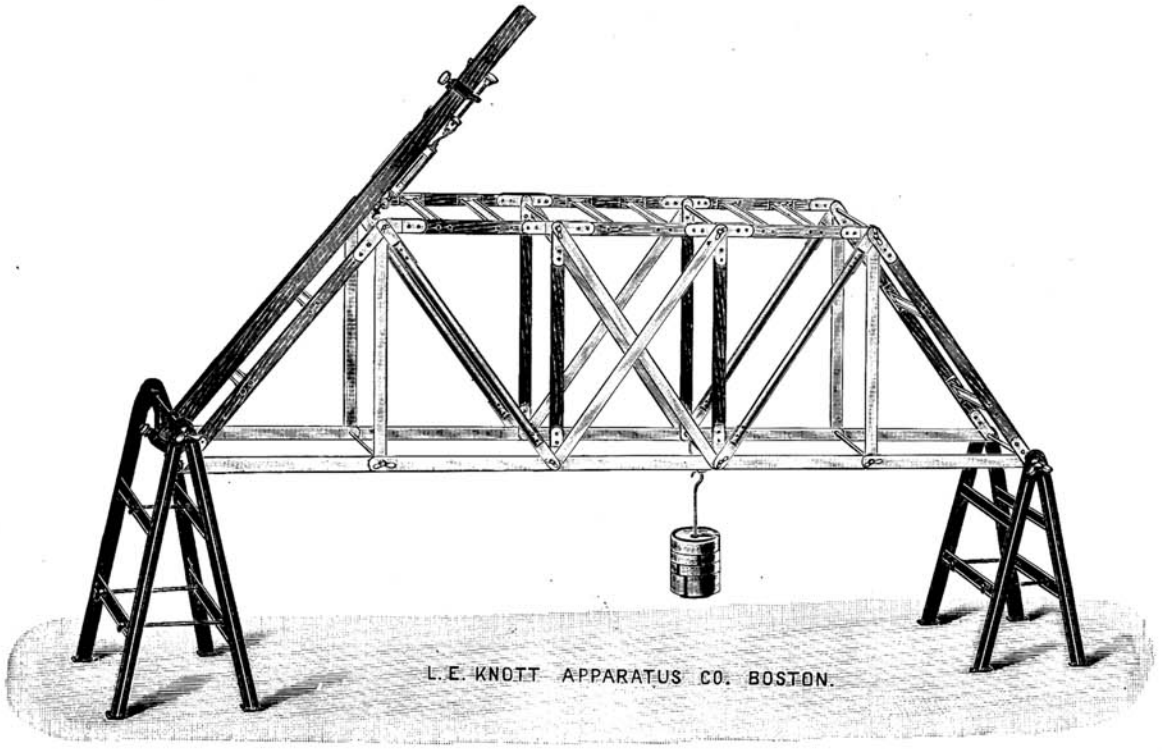
29–100 **ROOF TRUSS** for demonstrating the laws of equilibrium as manifest in the simple roof truss. Without balances, weights and hanger **11.50**

HARVARD EXPERIMENTAL BRIDGE TRUSS

Designed by

Prof. HARVEY N. DAVIS

Harvard University, Cambridge, Mass.



No. 29–110

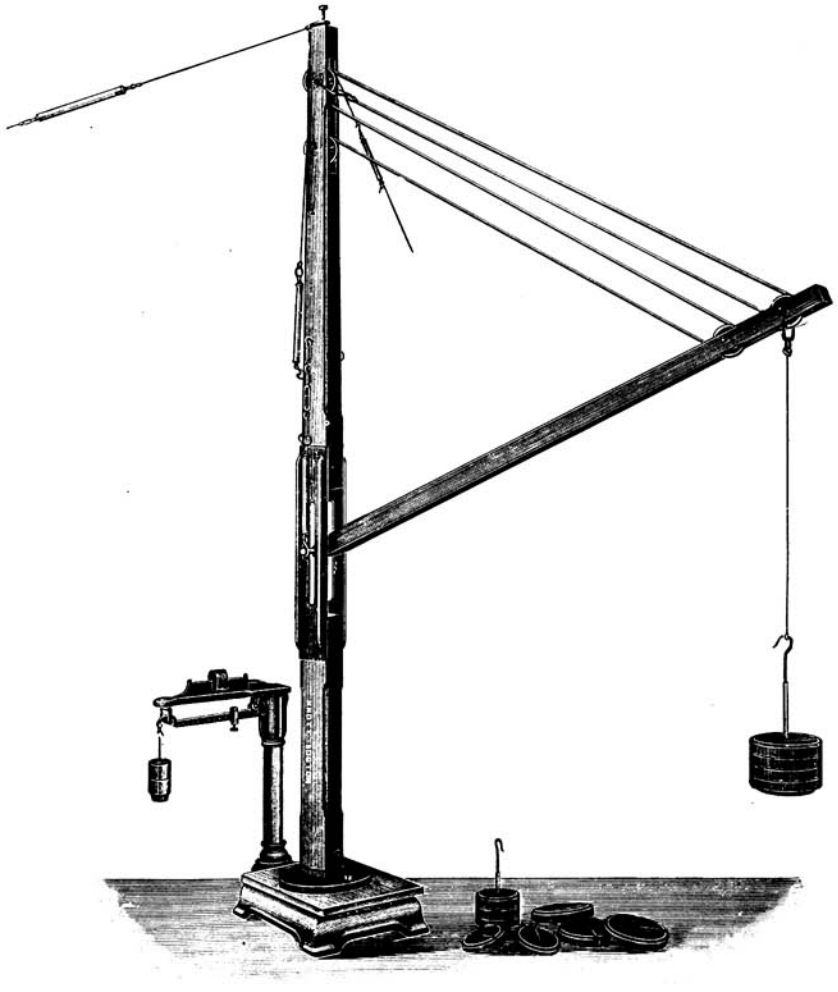
29–110 HARVARD EXPERIMENTAL BRIDGE TRUSS, 7½ feet long, for the study of reactions in a bridge truss. As all members are interchangeable, this model will serve to set up and demonstrate the reactions in a Simple Truss, a Four-Panel Pratt Truss, a Five-Panel Pratt Truss, a King Post Truss, an Underslung King Post Truss, a Cantilever Truss, etc. The members are constructed of solid mahogany strips with aluminum ends, aluminum strips and aluminum rods. The test member is of solid mahogany provided with special cast metal attachments for clamping to the pins and holding the dynamometers when measuring tensions or compressions on any of the members. The model is 7½ feet long, 4 feet high. Without abutments, height is slightly over 2 feet. Carrying capacity, 400 lbs. Weight of bridge, 14 lbs. An eight-page pamphlet containing a series of laboratory experiments and problems based upon this truss has been prepared by Prof. Harvey N. Davis of Harvard University and Mr. N. Henry Black of the Roxbury Latin School, and accompanies each outfit. Additional copies for students' use are furnished at a nominal cost.

Without weights and hanger, but otherwise complete as illustrated, including two special dynamometers for use on the test member. Shipped "knocked down" in a case which will be found convenient for storage when the truss is not in use.

PRICE, $75.00

For appropriate **Weights and Hanger,** see Section 16

LARGE HOISTING CRANE OR DERRICK



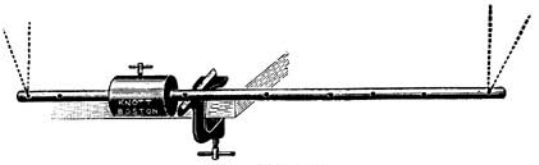
No. 29–125

29–125 LARGE HOISTING CRANE OR DERRICK, mast 8 feet high, boom 5½ feet long. The illustration will show at a glance the method of determining the various forces, such as the tension in the tie, the vertical and horizontal forces exerted by the boom against the mast, the amount and direction of the total force of the boom against the mast, the tension in each guy rope, the vertical and horizontal floor reactions at the foot of the mast, the horizontal component of the forces in the guy rope compared with the horizontal reaction at the foot of the mast. Without platform scale at the foot of the mast, balances, weights and hanger **$55.00**

29–130 PLATFORM SCALES for use with above **38.00**

For appropriate **Weights and Hanger,** see **Nos. 29–167** and **29–169** on following page, and Section 16

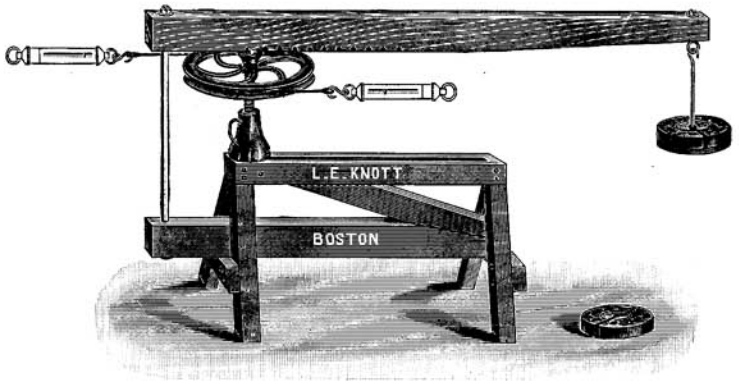
No. 29–145



No. 29–135

29–135 FORCES IN A UNIFORM METAL BAR 3 FEET LONG WITH SLIDING LOAD. With this apparatus the forces acting on a body supported by two cords not parallel, also by two cords parallel, may be definitely worked out. Without Knife-Edge Clamp **No. 5–596** illustrated..... **$9.75**

29–145 STEELYARD OF LARGE LABORATORY FORM. The apparatus is made from a uniform bar with measurable counterpoises and sliding weights. The apparatus is designed to be calibrated by the student according to the principles evolved in determining the center of mass in Uniform Bar experiments. Without weights, hanger, supporting clamps and stand..... **25.00**

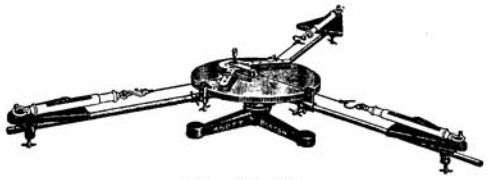


No. 29–165

29–165 SCREW JACK WITH WHEEL, BASE AND BAR. The efficiency test of the commercial screw jack has heretofore been considered out of the realm of laboratory work, even in technical schools. The use of adequate load to represent real conditions has not been feasible except by this method found so successful in Pratt Institute. With the apparatus the working load may be reckoned in **terms of tons,** while the power is in terms of **hundreds of pounds.** The apparatus is made up of a supporting base, a self-oiling commercial jack of best quality, a power wheel 18 inches in diameter grooved for cord, a lever arm 8 feet long capable of sustaining the 2-ton load and anchorage bar. Without weights and dynamometers..... **75.00**

29–167 FIFTY-POUND UNADJUSTED WEIGHTS for use with **Nos. 29–110, 29–125** and **29–165,** or wherever such a mass is desired.....Each **9.00**

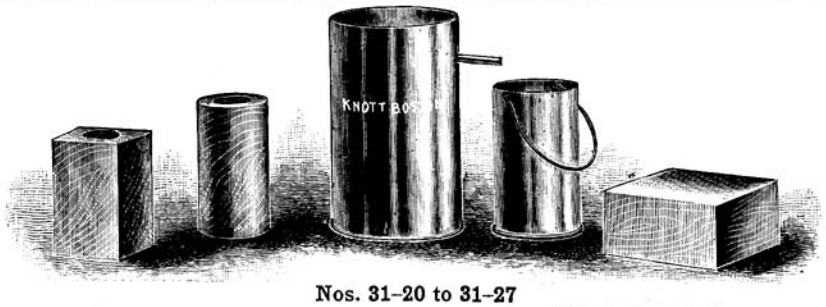
29–169 FIFTY-POUND UNADJUSTED HANGER for use with above weights..... **11.25**



No. 29–180

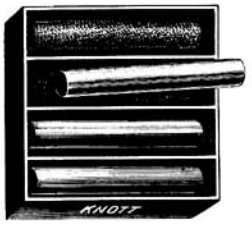
29–180 BENT-ARM LEVER AND SUPPORTING TABLE. This apparatus has been developed for the purpose of determining the relation between the forces acting on a lever. In its design special attention has been given to the eliminating of all directive forces due to gravity and friction, and enabling the use of forces of large dimensions. Without dynamometers..... **95.00**

No. 31–10



Nos. 31–20 to 31–27

No. 31–35



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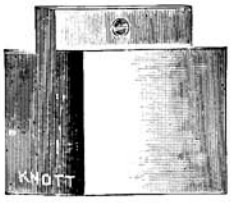

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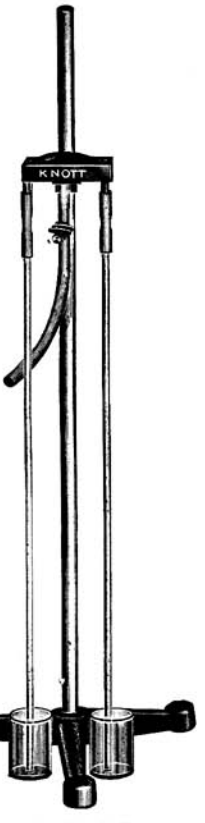
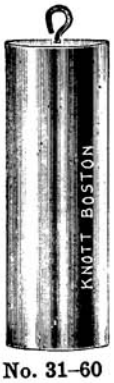


No. 31–145



No. 31–60

No. 31–125

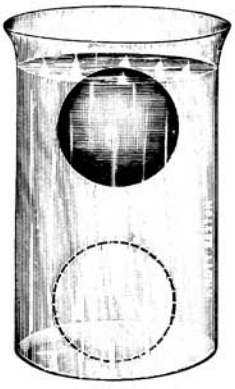
No. 31–130c

No. 31–135

No. 31–140

31–10	**ARCHIMEDES' PRINCIPLE BUCKET AND CYLINDER,** polished and lacquered brass	$2.25
31–20	**OVERFLOW CAN,** nickel-plated	.95
31–21	**CATCH BUCKET,** nickel-plated	.55
31–23	**LOADED WATERPROOFED WOODEN CYLINDER,** 3¼ inches long, 1⅝ inches diameter, loaded to just sink in water	.30
31–25	**WATERPROOFED HARDWOOD BLOCK,** 3×3 inches by 1½ inches thick	.20
31–27	**LOADED WATERPROOFED RECTANGULAR BLOCK,** 1¾ inches square by 2¾ inches high.	.30
31–35	**LEAD SINKER,** with small brass hook	.25
31–40	**SULPHUR SPECIMEN,** about 3 inches long by 1½ inches diameter	.15
31–55	**ALUMINUM BLOCK,** pure metal, 1½ inches on an edge	1.00
31–60	**ALUMINUM CYLINDER** (see Millikan, Gale & Bishop, Exp. 6)	.95
31–65	**PARAFFINE CUBE,** 5 cms. on an edge, weight approximately 100 grams	.45
31–67	**SPECIFIC GRAVITY SPECIMENS,** one each of aluminum, brass, steel and hard rubber rods, accurately machined, ½×2 inches; in box	1.85
31–70	**SPECIFIC GRAVITY SPECIMENS,** twenty assorted specimens of irregular shapes in box	.75
31–97	**WATERPROOFED WOODEN ROD,** 20 cms. long by 1 cm. diameter, for determination of specific gravity by flotation method	.12
31–100	**BRASS SUPPORT WITH CLAMP** for clamping to the side of a battery jar to hold **No. 31–97** Rod in a vertical position	.45
31–125	**SPECIFIC GRAVITY BOTTLE (PYKNOMETER),** with **GROUND-IN CENTIGRADE THERMOMETER.** With stoppered capillary tube. Capacity 50 cc.	4.50
31–130	**SPECIFIC GRAVITY BOTTLES (PYKNOMETERS), accurately adjusted,** with perforated stoppers ground into necks.	
	Capacity, cc. — a: 10 — b: 25 — c: 50 — d: 100	
	Each — a: $2.20 — b: $2.40 — c: $2.70 — d: $3.00	
31–132	**SPECIFIC GRAVITY BOTTLE (PYKNOMETER), not adjusted,** with perforated stopper ground into neck. Capacity 25 cc	1.45
31–135	**SPECIFIC GRAVITY BOTTLE** — a glass-stoppered bottle of convenient size; frequently desired by instructors in preference to the specially adapted types	.20
31–140	**VACUUM WALLED SPECIFIC GRAVITY BOTTLE WITH CAPILLARY STOPPER.** Capacity 25cc.	2.75
31–145	**HARE'S BALANCING COLUMNS APPARATUS, special three branch lead tube.** Without upright support, but otherwise complete as illustrated	2.60
31–145a	**SPECIAL THREE BRANCH LEAD TUBE**	.50
31–145b	**GLASS TUBES**	Pair .35
31–265a	**GLASS JARS,** 2¼×3¼ inches	Pair .56
4032a	**SCREW COMPRESSOR**	.25
5–125	**TRIPOD BASE**	1.80
5–15d	**SUPPORT ROD,** 80 cms. long, 13 mm. diameter	1.20
31–145f	**SUPPORT CLAMP,** special design for **No. 31–145a**	.95

No. 31–171



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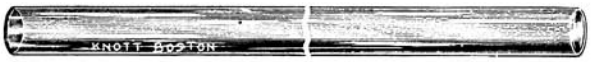
No. 31–250



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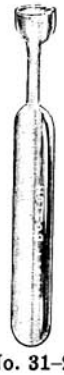

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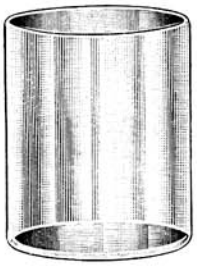

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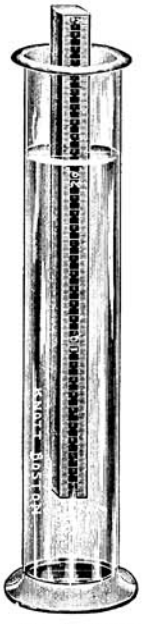

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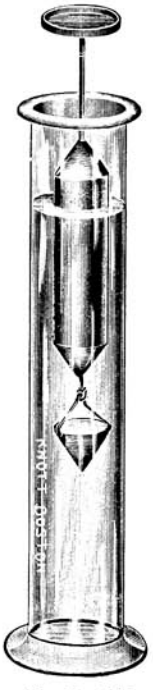


No. 31–240

31–160 **DENSITY INDICATING BALL** for illustrating the changes in the density of a liquid induced by variations in temperature. The hollow metal ball, 75 mm. diameter, is adjusted to float in cold water. It will sink in warm water **$5.75**

31–170 **CONSTANT WEIGHT HYDROMETER** for finding specific gravity of light liquids, Beaumé scale 70–10, specific gravity scale 0.7000 to 1.000 ..... **1.00**

31–171 ——, for finding specific gravity of heavy liquids, Beaumé scale 0–70, specific gravity scale 1.000 to 2.000 ..... **1.00**

31–175 ——, for finding specific gravity of both light and heavy liquids **2.25**

For **Other Hydrometers** see page 255.

31–225 **CONSTANT VOLUME HYDROMETER TUBE** (see Millikan, Gale & Bishop) ..... **.50**

31–227 **CONSTANT WEIGHT HYDROMETER TUBE** (see Millikan, Gale & Bishop) ..... **.60**

31–230 **DEMONSTRATION HYDROMETER** illustrating the principle of the hydrometer and method of determining specific gravity of liquids by buoyancy. A waterproofed rod, 30 cms. by 1 cm. square, graduated to millimeters, loaded at end to float upright. Without jar ..... **.28**

31–240 **NICHOLSON'S HYDROMETER** for determining the density of a body heavier than water. A constant volume hydrometer constructed of metal. Without jar **3.50**

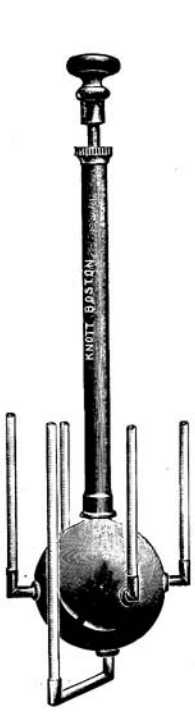
31–250 **CLEAR WHITE GLASS HYDROMETER JARS** for use where a tall jar of small diameter is desired.

	a	b	c	d	e
Size, inches	12×1½	12×2	15×2	15×3	18×3
Price	**$1.15**	**$1.25**	**$1.75**	**$2.00**	**$3.00**

31–265 **GLASS JARS,** of excellent quality.

	a	b	bb	c	d
Size, inches	2¼×3¼	4×5	4½×4½	6×8	8×12
Price	**$0.28**	**$0.40**	**$0.55**	**$0.60**	**$2.25**

PRESSURE OF LIQUIDS



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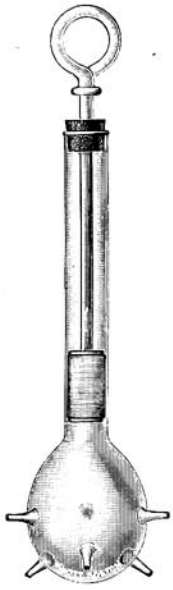
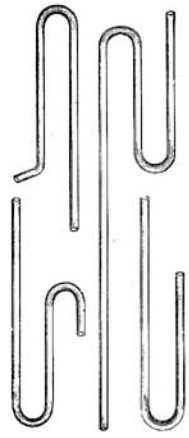


No. 32–35

No. 32–62

No. 32–50



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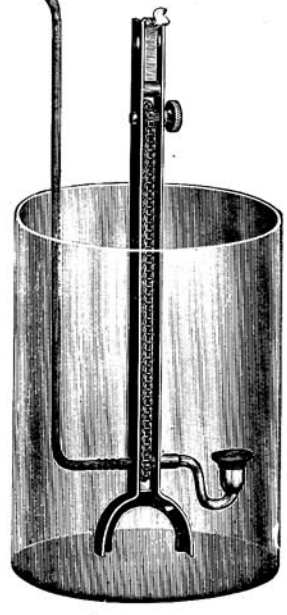


No. 32–60

32–30 LARGE DEMONSTRATION MODEL BRASS UNIFORM PRESSURE SYRINGE for demonstrating that the pressure of liquids is equal in all directions against the sides of the containing vessel. The indicating tubes are of glass and are sealed water-tight in metal bosses attached to the spherical body. The pressure is secured by means of a piston operating in the brass tube..... **$28.50**

32–35 GLASS UNIFORM PRESSURE SYRINGE. The equality of pressure on all sides is indicated by the distances to which the various streams spout when pressure is transmitted by means of the piston..... **2.25**

For **Incompressibility of Liquids Apparatus** see **No. 20–260**

32–50 PRESSURE GAUGE WITH EQUALIZING TUBE (See Cheston, Dean & Timmerman, Exp. 4) for measuring directly the pressure of liquids at various depths..... **1.25**

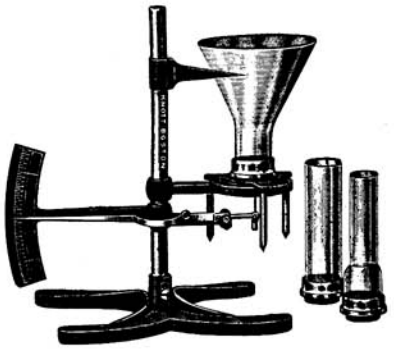
32–60 CAST METAL CHAIN-DRIVE PRESSURE GAUGE WITH EQUALIZING TUBE for demonstrating that pressure upon a surface varies with the depth but not with the angle of inclination. Face of diaphragm is changed to various positions by chain and sprocket shown in illustration. Illustration shows use of **No. 32–62** in projecting globule of mercury on the screen. Without jar or Projection Holder **No. 32–62,** but with manometer tube..... **4.50**

32–62 PRESSURE GAUGE PROJECTION HOLDER as designed by Dr. Hall for use in any standard lantern slide carrier in projecting the indicating globule of mercury in manometer tube of **No. 32–60** **1.35**

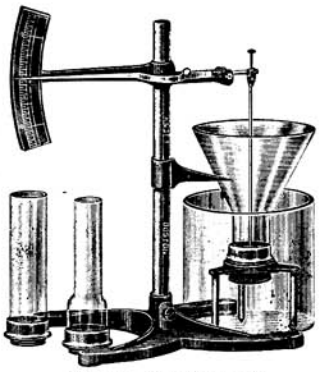
32–66 LIQUID PRESSURE GAUGE, simple form, a pressure chamber with index tube mounted on a graduated rod..... **1.10**

32–70 GLASS MANOMETER TUBE (See Millikan, Gale & Bishop, Exp. 4)..... **.45**

32–75 GAGE'S PRESSURE TUBES. Four U-tubes with shorter arms bent so that the openings may be placed to indicate pressure upward, downward and sideways. Set of four tubes..... **1.25**

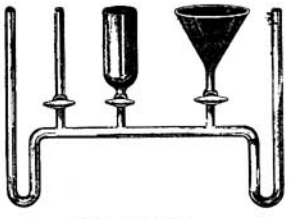


No. 32–100 (Fig. 1)

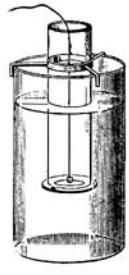


No. 32–100 (Fig. 2)

No. 32–110



No. 32–115



No. 32–120

32–100 NICHOLS'S UPWARD OR DOWNWARD PRESSURE PASCAL'S VASE APPARATUS for quantitative determination of the laws governing liquid pressure,— **upward or downward pressure distinctive to this design.** Illustrates also that pressure upon a surface is independent of the shape of the containing vessel. Fig. 1 shows apparatus assembled for downward; and Fig. 2, for upward pressure. In either arrangement the pressure is transmitted through a flexible membrane to a multiplying lever operating as shown.

For **Downward Pressure** (Fig.1) the Pascal's Vase is filled to a certain point indicated by the pointer.

For **Upward Pressure** (Fig. 2) the glass jar is filled until an appreciable pressure on the diaphragm is indicated by the multiplying lever. The Pascal's Vase can then be filled to quantitatively measure this pressure. Complete as illustrated with three Pascal's Vases..... **$18.50**

32–110 PASCAL'S VASES WITH BALANCE ARM AND WEIGHT. The pressure is visibly indicated by the weights on the long arm of the balance. A brass disc ground to fit the cast receptacle for the Pascal's Vases is attached to the short arm of the balance. Complete as illustrated..... **11.50**

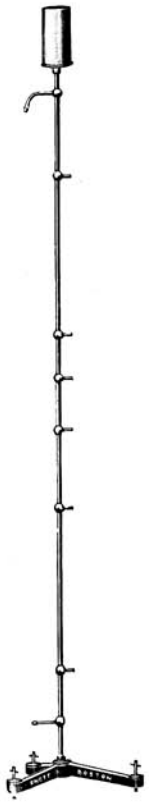
32–115 SELF-CONTAINED PASCAL'S VASE APPARATUS. Made entirely of glass. The Pascal's Vases are connected through stopcocks of equal bore to a common tube terminating at each end in manometer tubes which in use should have mercury in the bends to act as the pressure indicator. This design is highly recommended..... **7.40**

32–120 BUOYANCY OF LIQUIDS APPARATUS for illustrating upward pressure. Glass cylinder supported as illustrated, the lower end being closed by a ground metal disc. Complete with jar..... **3.50**

32–134 LOADED GRADUATED LIQUID PRESSURE TUBE (see Fuller and Brownlee, Exp. 8)..... **.50**

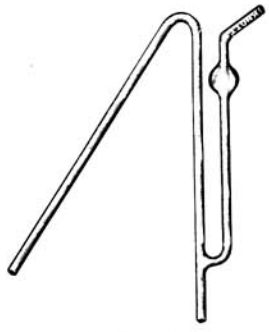
32–135 PRESSURE U-TUBES for experiments in fluid pressure. Arms of equal lengths.

	a	b	c	d	e
Length, cms.....	10	12.5	15	30	50
Price.....	**$0.25**	**$0.35**	**$0.45**	**$0.60**	**$0.75**



No. 32–165

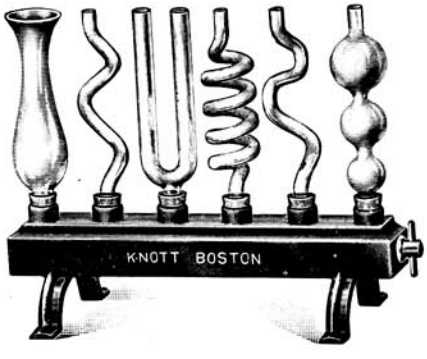
No. 32–200



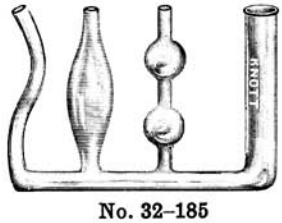
No. 32–205

No. 32–210

No. 32–215



No. 32–180



No. 32–185

No. 32–230

32–165 **EIGHT-IN-ONE or TORRICELLIAN LAW APPARATUS, 6 feet high** (see Gage's "Introduction to Physical Science," Exp. 32) for demonstration of the law $s = \sqrt{2gh}$ when "s" equals the speed of efflux, "g" equals gravity, and "h" the height of the liquid; also for simple demonstration of variable pressure according to depth below the free surface of the liquid. The tube is 6 feet high, with a metal reservoir; the lateral tubes are provided with screw caps which can be successively opened to allow efflux of water. Complete as illustrated **$18.75**

32–180 **LIQUID LEVEL APPARATUS WITH CAST METAL WATER RESERVOIR,** illustrating the tendency of a liquid to seek its own level. Both branches of the U-shaped tube are equal in area. **7.25**

32–185 **LIQUID LEVEL COMMUNICATING TUBES** for illustrating the tendency of a liquid to seek its own level **1.25**

32–200 **SIMPLE SIPHON,** length of arm 12 inches ..... **.45**

32–205 **SIPHON WITH SUCTION TUBE** ..... **.75**

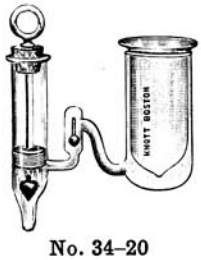
32–210 **AUTOMATIC SIPHON,** simple demonstration form. **Flow starts automatically** as soon as the open end of siphon tube is below the surface of the liquid ..... **.60**

32–215 **TANTALUS CUP or INTERMITTENT FOUNTAIN,** demonstrating the principle of intermittent springs. As water rises in the goblet, it enters the short arm of the siphon. When it rises to the bend it flows down the long arm and will continue to flow until the water level reaches the lower end of the short arm **1.50**

32–230 **CARTESIAN DIVER** illustrating the effects of suspension, immersion and floating. With jar and rubber cap complete **1.75**

32–231 **CARTESIAN DIVER,** only ..... **.55**

HYDRAULIC POWER DEMONSTRATION APPARATUS



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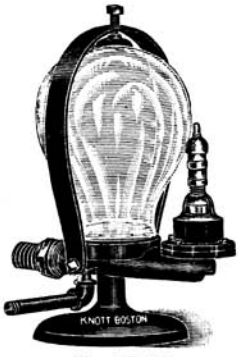

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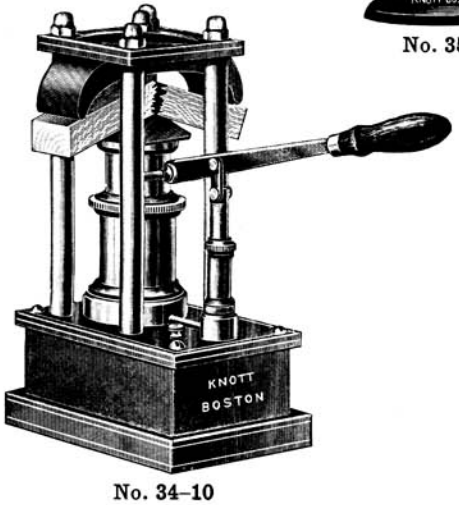
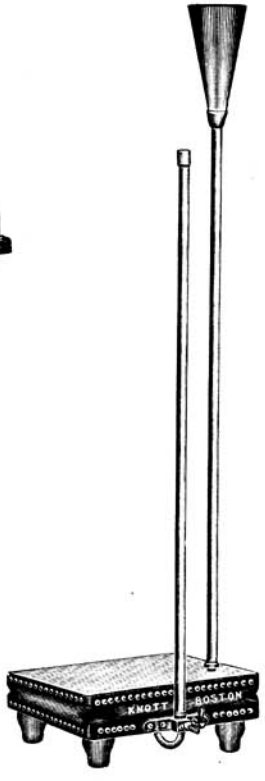


No. 34–10



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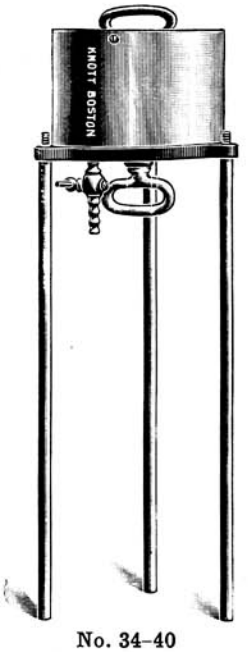


No. 34–40

34–10 HYDRAULIC POWER PRESS for illustrating the commercial value of a hydraulic press in exerting a great force at the expense of little power. Constructed of cast iron, bronze and steel throughout. Internal diameter of cylinder, 2½ inches, piston 7/16 inch diameter. We suggest the use of oil and not water in working this or any other hydraulic press, as oil prevents wear on the working parts. . **$82.50**

34–20 GLASS MODEL HYDRAULIC PRESS. All parts visible to show principle of a hydraulic press. . **2.50**

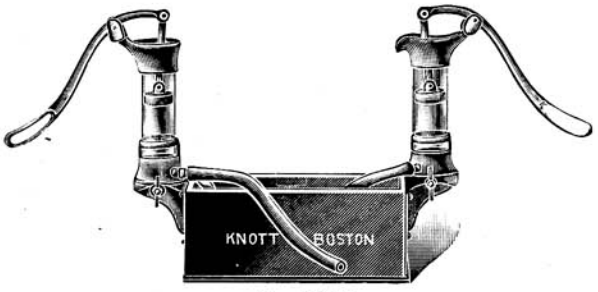
34–30 SIX-FOOT WATER HEAD HYDROSTATIC BELLOWS for demonstration and application of Pascal's Law. The upright tube is made in two parts for convenience in shipping and storing. Bellows of reinforced rubber of superior quality, approximately 30 cms. square. **55.00**

34–40 SEVEN-IN-ONE APPARATUS or **SPIROMETER** for demonstrating fundamental principles in pneumatics and hydraulics. The cylinder is seamless brass, 6 inches in diameter. Rods may be screwed in from either side of the metal cap casting. Handle in piston head is detachable. This design will illustrate principles involved in seven different instruments: Hydraulic Lift, Hydraulic Press, Incompressibility of Liquids Apparatus, Pascal's Law Apparatus, Pneumatic Lift, Hydrostatic Bellows, and Magdeburg Hemispheres. **18.50**

35–20 COMMERCIAL DEMONSTRATION HYDRAULIC RAM WITH GLASS AIR CHAMBER. The working parts can be seen in actual operation. Can be used as a practical commercial appliance. . **36.00**

MODELS OF PUMPS AND VALVES

No. 35–30



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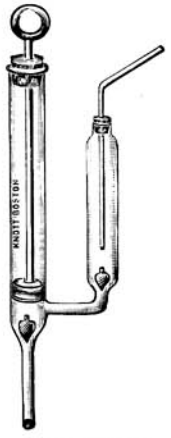
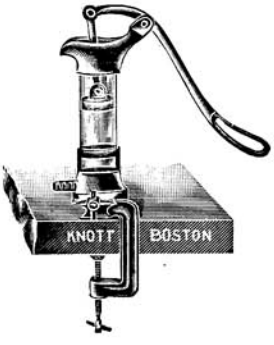
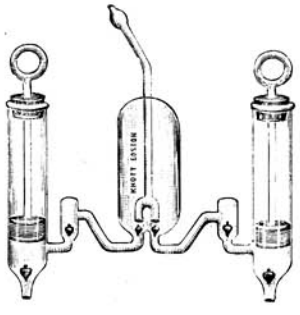


No. 35–32



No. 35–50



No. 35–40

No. 35–52

No. 35–75

35–30 **GLASS MODEL LIFT PUMP,** valves of colored glass, ground to fit valve seats..... **$2.25**

35–32 **GLASS MODEL FORCE PUMP,** valves of colored glass, ground to fit valve seats..... **2.50**

35–40 **GLASS MODEL FIRE ENGINE FORCE PUMP,** valves of colored glass, ground to fit valve seats. **4.50**

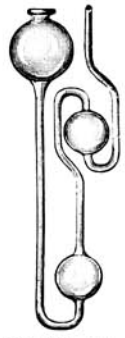
35–50 **T-BEAM COMMERCIAL TYPE WATER LIFT PUMP, 1½-inch cylinder.** With clamp for attaching to table..... **16.50**

35–52 **T-BEAM COMMERCIAL TYPE WATER FORCE PUMP, 1½-inch cylinder.** With clamp for attaching to table..... **17.00**

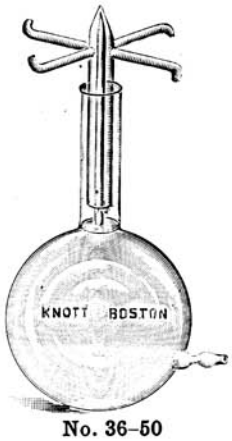
35–55 **T-BEAM LIFT AND FORCE PUMPS, Nos. 35–50** and **35–52** without clamps, but attached to metal tank as illustrated..... **43.25**

35–57 **CAST METAL WATER TANK** as used in **No. 35–55**..... **9.75**

35–75 **MODELS OF VALVES, 6 inches diameter.** Five models demonstrating the most important valve types as follows: Butterfly Valve, Bellows Valve, Round Spring Valve, Conical Valve, and Oil Silk Valve. Set of five..... **10.00**

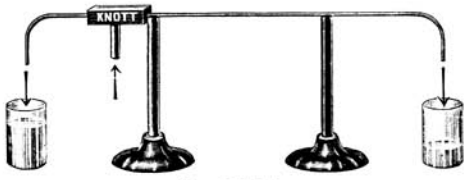


No. 36–12



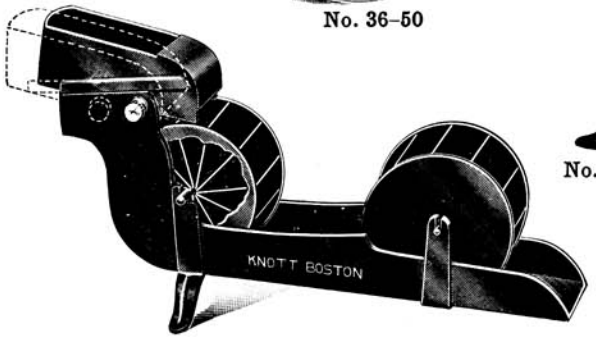
No. 36–50

No. 36–30



No. 36–75

No. 37–30



No. 37–50

No. 37–20

36–12 HERO'S FOUNTAIN, illustrating the raising of water by the elastic force of air. Made entirely of glass, in form as illustrated. In operation, the upper bulb is first filled with water, the lower with air. The fountain is started by pouring a small quantity of water into the reservoir. As this flows down, it exerts a pressure on the air contained in the lower bulb. This pressure is transferred to the water in the upper bulb and forces it out through the fountain nozzle..... **$4.25**

36–30 REACTION APPARATUS, glass, illustrating the reactive force of a laterally escaping stream of water. With stationary indicating point..... **1.60**

36–50 REACTION GAS AND FLAME WHEEL for determining the reaction set up by gas escaping from a lateral opening. If illuminating gas is used and the escaping gas ignited, the effect is most spectacular. **4.25**

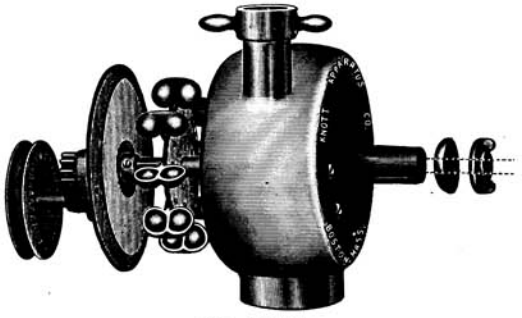
36–75 HALL'S APPARATUS FOR STUDYING WATER FRICTION IN PIPES, for demonstrating resistance to flow due to friction of water in pipes. The two branches of liquid tube have same diameter but are different in length. Pressure of water introduced through inlet tube will be same in both branches, but approximately twice the volume will flow out of shorter branch. Without glass jars. **4.25**

37–20 WORKING MODEL OF WATER TURBINE. Reactions are clearly visible through the glass portion. **9.50**

37–30 HARCOURT IMPROVED WORKING MODEL OF WATER TURBINE. Working parts painted in different colors so that reactions are clearly visible through plate glass front. This model is built to develop power for lecture table demonstration, as well as to show actual operation of the parts.... **18.50**

37–50 CAST METAL WATER WHEEL MODEL for study and demonstration of overshot, undershot and breast water wheels. All parts, except wheels which must be kept as light in weight as practicable, are cast iron. The reservoir is illustrated to demonstrate an overshot water wheel. When moved back to position shown by dotted lines the model demonstrates an undershot water wheel. The lower wheel operates as a breast water wheel..... **11.50**

WATER MOTORS



No. 38–20

No. 38–25

38–20 **THE IMPROVED WALTHAM COUNTERSHAFT GEARED WATER MOTOR.** Should not be confused with the less expensive and correspondingly less efficient types on the market. It is built along scientific lines and all parts are constructed of the best materials, finished and assembled by skilled workmen.

The success of this motor is due to the following features:

First. The employment of the well-known reacting bucket-wheel which has proved by a series of scientific tests to give the highest efficiency in a wide range of work.

Second. The reducing gear which enables the wheel to give very much more power, the wheel itself running at its normal speed for greatest efficiency.

Third. A gear which is easily thrown in and out of mesh so that it may be used or not, as desired.

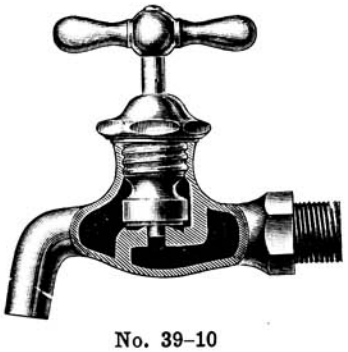
The uses for such a motor in the science laboratory are numerous, taking the place of the whirling table, supplying small power for the small-size electric generators, the operating of stirring devices, and the study of the efficiency test by means of the prony break. We believe we offer in this design the first satisfactory motor for scientific laboratories. It will give efficient results under a wide variety of conditions **$15.50**

38–25 **THE HARCOURT ⅛ H. P. DIRECT DRIVE WATER MOTOR,** a substantial, attractive, well-built motor of careful design giving unusual power for its size. Motor complete with 4-inch beveled-face emery wheel, cloth buffing wheel, cake of polish and the grooved wooden pulley. Motor and parts securely packed for shipment in a wooden box **6.50**

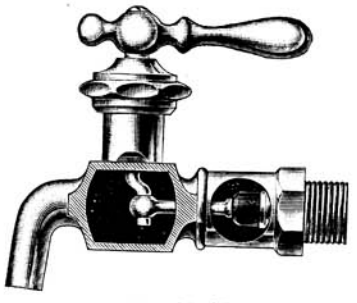
38–26 **HARCOURT ¼ H. P. DIRECT DRIVE WATER MOTOR,** same in design as above, but without accessories **8.75**

38–29 **WATER MOTOR ACCESSORIES,** as supplied with our ⅛ H. P. Motor, **No. 38–25.** These accessories may be attached to our ¼ H. P. Motor **No. 38–26.** They are as follows:

1 Cloth Buffing Wheel
1 Beveled-face 4-inch Emery Wheel
1 Cake Brass Polish
1 Grooved Wooden Pulley
Per set **3.75**



No. 39–10



No. 39–15

39–10 **DEMONSTRATION COMPRESSION BIBB.** A commercial hose bibb cut open to show interior mechanism, all parts of which are left free to move to show office of various parts in the " shutting off " or " turning on " of water in a compression bibb **3.65**

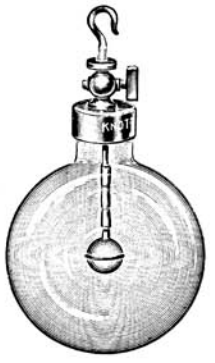
39–15 **DEMONSTRATION FULLER BIBB.** A commercial hose bibb cut open to show interior mechanism, all parts of which are left free to move to show office of various parts in the " shutting off " or " turning on " of water in a Fuller bibb **3.95**

PNEUMATICS

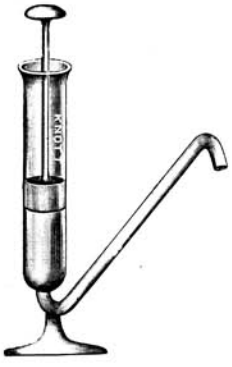
No. 40–10

No. 41–70

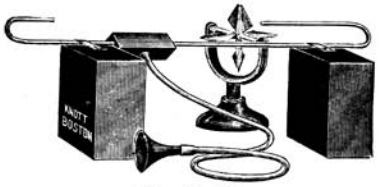
No. 41–71



No. 40–22



No. 41–10



No. 41–40

No. 41–60

40–10 **BAROSCOPE GLOBE AND BALANCE** for demonstrating that air has weight. **Hollow Brass Globe,** 4¼ inches in diameter, with stopcock with male screw, and hook. **Balance with Counterpoise** — counterpoise accurately adjusted to weight of brass globe. Without bell glass, but with balance, counterpoise, and brass globe complete as illustrated **$15.00**

40–15 ——, **glass globe** in place of brass **15.00**

40–17 **BAROSCOPE BALANCE** as used in above, but without counterpoise **4.00**

40–18 **BRASS BAROSCOPE GLOBE AND COUNTERPOISE** as used in **No. 40–10** **11.00**

40–19 **GLASS BAROSCOPE GLOBE AND COUNTERPOISE** as used in **No. 40–15** **11.00**

40–22 **COMBINED BAROSCOPE GLOBE AND BELL-IN-VACUO** for use as a Baroscope Globe in determining weight of air, or as a Bell-in-Vacuo in illustrating non-transmission of sound in a vacuum. The globe is of glass, 4¼ inches diameter **7.85**

40–55 **BAROSCOPE BOTTLE,** (See National Physics Direction Sheets, Exp. M260). Two-liter bottle with rubber stopper, glass and rubber tubing connections **1.00**

41–10 **MERCURY STORAGE FUNNEL** about 8½ inches high, for storage and delivery of mercury in cleanly condition **3.25**

41–40 **FRICTION OF AIR APPARATUS** for illustrating friction of air in tubes. Complete as illustrated .. **4.85**

41–60 **PRESSURE GAUGE, steam or air,** for pressures up to 150 lbs. Iron case with nickel-plated ring, dial 3 inches diameter **6.30**

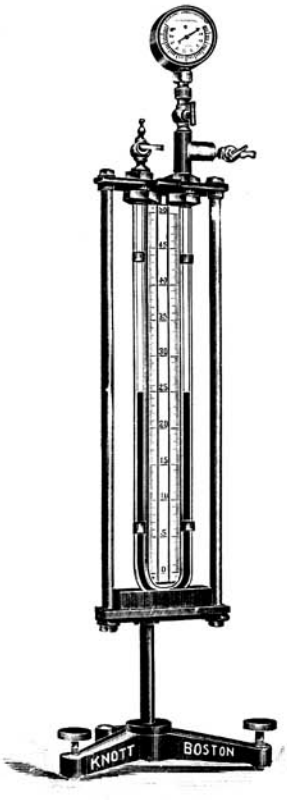
41–65 **VACUUM GAUGE,** same type and quality as above but graduated to read a vacuum from 0–30 inches of mercury **6.00**

41–70 **DEMONSTRATION PRESSURE AND VACUUM GAUGE** with silvered metal graduated scale; highest quality, glass front permitting full view of the mechanism. May be used under a bell glass or connected directly by tubing to a presssure or vacuum chamber. Diameter 5 inches; graduated to read 0-75 lbs. per square inch (approximately 150 lbs. pressure) and a vacuum from 0-30 inches of mercury **14.50**

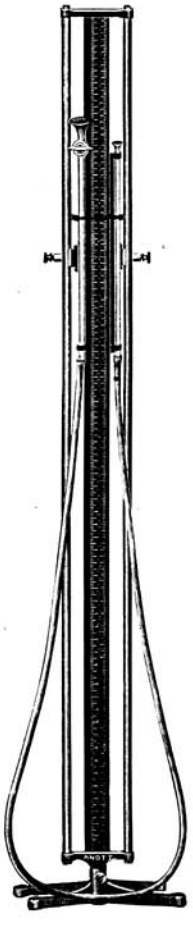
41–71 **DEMONSTRATION BOURDON GAUGE** for demonstrating the principle of a Commercial Bourdon Gauge **11.00**

41–72 **COMBINATION PRESSURE AND VACUUM GAUGE,** same type and quality as **Nos. 41–60** and **41–65.** Reads 0-75 lbs. per square inch and 0-30 inches **9.25**

No. 41–105



No. 41–100



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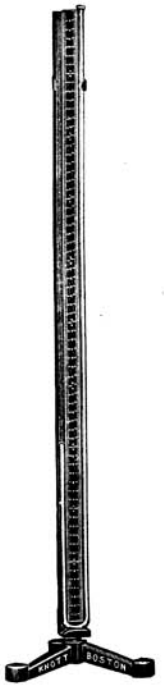
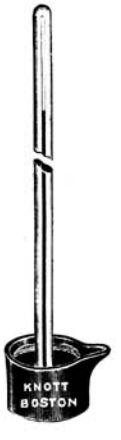


No. 41–115

No. 41–157



Nos. 41–155 and 41–160

41–100 **HIGH PRESSURE BOYLE'S LAW APPARATUS** for the accurate determination of Boyle's Law up to a pressure of ten atmospheres. An exceptionally well-made instrument capable of accurate results. With pressure gauge **$52.00**

41–105 **ADJUSTABLE SCALE BOYLE'S LAW APPARATUS** (see Crew and Tatnall's "Laboratory Manual of Physics," Ex. 37), for determining Boyle's Law for pressures ranging between ½ and two atmospheres **7.25**

Hand Air Pump No. 42–76 recommended for use with the above apparatus.

41–110 **FIVE-FOOT ADJUSTABLE BOYLE'S LAW APPARATUS** for the determination of Boyle's Law. Both the closed and open tube are attached to a wooden strip fastened to a special clamp adjustable along the upright rods. Each tube provided with a movable grass indicator **16.50**

41–114 **MILLER'S COMBINATION PRESSURE TUBE** for use on **No. 41–116.** A U-tube, one meter long, with one arm open and the other terminating in an air-tight stopcock. In use as a pressure tube, stopcock is left open; as a barometer tube, the stopcock is left open until the tube has been filled with mercury, then it is closed; as a Boyle's Law tube, the stopcock is left closed **3.50**

41–115 **SIMPLE ADJUSTABLE SCALE BOYLE'S LAW APPARATUS** for the determination of Boyle's Law. A heavy-walled U-shaped glass tube with funnel top, mounted on an improved, adjustable scale support. The tube is attached by a single clamp which serves also as an indicator **5.85**

41–116 **ADJUSTABLE SCALE BOYLE'S LAW STAND** as used in above **4.60**

41–120 **EXTRA HEAVY J-SHAPED BOYLE'S LAW TUBE** **1.25**

41–126 **BOYLE'S LAW TUBE, unfilled** (see Millikan, Gale & Bishop, Exp. 9) ..... **.65**

41–130 **TRIPOD, ROD, UNIVERSAL CLAMP AND HOLDER** (see Millikan, Gale & Bishop, Exp. 5, etc.) **3.30**

41–155 **HEAVY-WALLED BAROMETER TUBE,** 80 cms. long ..... **.65**

41–157 **——, graduated** entire length to millimeters from zero at open end **3.25**

41–160 **GILLEY IMPROVED MERCURY WELL,** minimum amount of mercury required ..... **.55**

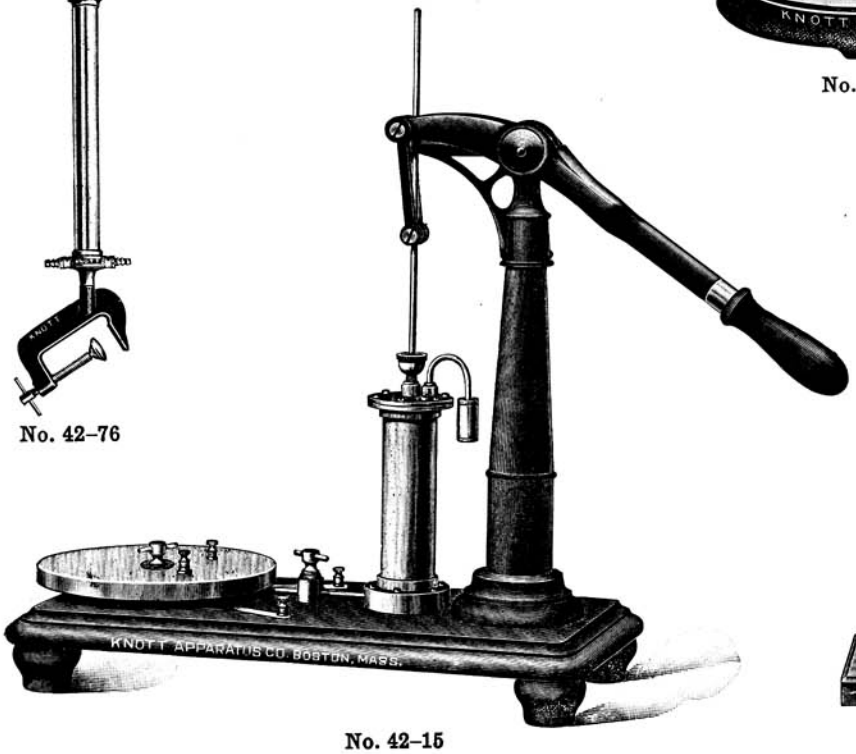
For **Bell Glass** for use with **Nos. 41–160** and **41–155** or **41–157** in study of barometric pressures, see **No. 43–82.**

THE RITCHIE AIR PUMPS

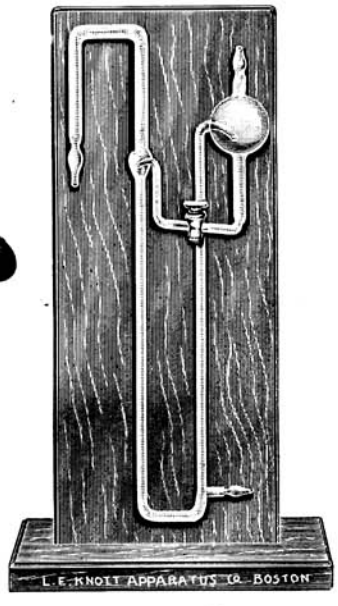
With the many vast improvements which have, in the past few years, been made in oil-sealed pumps, the question may reasonably be asked why we continue to make the Ritchie Pumps. The answer is clear when we consider that the most minute details of construction have been worked out through years of experience and the manufacturer is, therefore, no longer in doubt as to the correct weight and kind of material to use in the valve and other essential parts, the form of the valve seat and method of grinding which will give the best results. Such matters of detail as the fitting of the plunger, the grinding of all internal parts, and a multitude of other points which must be carefully worked out in order to make sure that a pump will give permanent satisfaction, have been reduced to definite manufacturing terms, with the result that we are able to produce, at a definite price, an instrument in which we can guarantee a high degree of efficiency.

No. 42–76

No. 42–82



No. 42–15



No. 42–100

42–10 **THE RITCHIE STANDARD AIR PUMP**, cylinder 2¼ inches by 7-inch stroke. Plate 10 inches in diameter **$48.00**

42–15 **THE RITCHIE SUPERIOR AIR PUMP**, same as above, except that the plate is equipped with insulated binding posts as illustrated **55.00**

42–76 **CONDENSING AND EXHAUSTING HAND AIR PUMP.** Cylinder, 1 inch by 11½-inch stroke. Superior construction throughout. Complete with clamp for attachment to table top, etc..... **6.25**

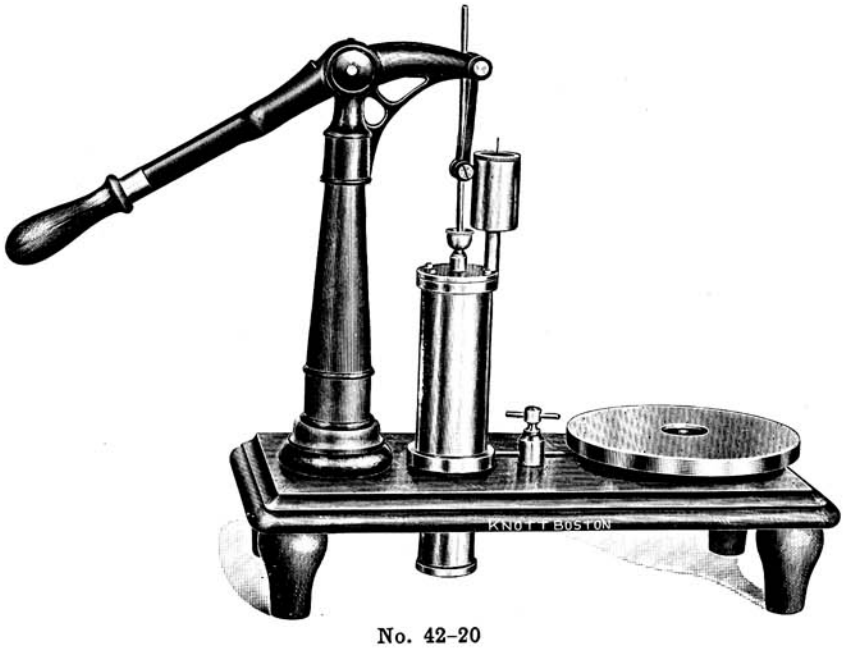
42–80 **AIR PUMP PLATE, 10 inches diameter,** surface ground true and plane; vent tapped for accessories. On tripod base with guard plug and stopcock **9.50**

42–82 **TEN-INCH GROUND HEAVY PLATE GLASS PUMP PLATE**, mounted on cast metal base. With stopcock, guard plug, and oil-sealed taps for inlet of air and manometer..... **18.50**

42–100 **MOUNTED BOLTWOOD MERCURY PUMP.** Requires but a small amount of mercury..... **22.50**

42–102 **BOLTWOOD MERCURY PUMP**, glass part only..... **13.50**

THE INSTITUTE OIL-SEALED AIR PUMPS



No. 42-20

For work requiring the highest vacuum, the oil-sealed pump has been very generally recognized. The defects as well as the strong points of the old form of oil pump have been very carefully studied with the result that we are able to offer a pump in which the defects of the older pumps have been entirely eliminated. Our new type is rapid in action and **guaranteed not to squirt oil from the cylinder.** This latter difficulty has been common heretofore in practically all of the oil pumps on the market. Our pump is also capable of an extraordinarily high degree of vacuum.

The test which we have found most practical is the electrical discharge in the exhausted chamber, and no pump passes our inspection department until it has produced a satisfactory X-Ray vacuum.

The operating part consists of a substantial metal cylinder alternately raised and lowered into a fluid chamber filled with oil of the lowest possible vapor tension. This action results in a Torricellian vacuum being produced in the cylinder at each stroke. At the proper place in the stroke the air is allowed to flow from the chamber being exhausted into the cylinder, and the operation is thus continued.

It will be noted that we obtain in a single cylinder all the advantages of two cylinders in tandem frequently used by manufacturers of oil pumps. This is made possible from the fact that air taken from the lower side of the cylinder to produce the Torricellian vacuum in the lower chamber is forced into the upper chamber, from which it is in turn expelled, a Torricellian vacuum being formed in the upper portion of the chamber. It will thus be seen that the degree of vacuum depends upon the vapor tension of the fluid used.

The simplicity of design enables all parts to be of most substantial construction. The absence of delicate valves to become worn and thrown out of adjustment insures the continued operation of the pump and its dependable qualities.

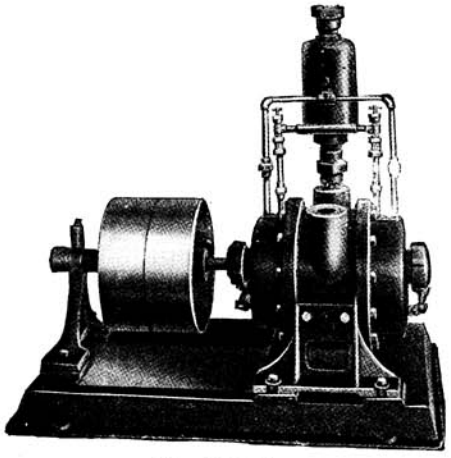
42-20 INSTITUTE OIL-SEALED AIR PUMP "A." Cylinder 2⅛ inches by 5-inch stroke. Plate 10 inches in diameter..... **$65.00**

42-25 INSTITUTE OIL-SEALED AIR PUMP "B." Cylinder 2½ inches by 8-inch stroke. Plate 10 inches in diameter..... **75.00**

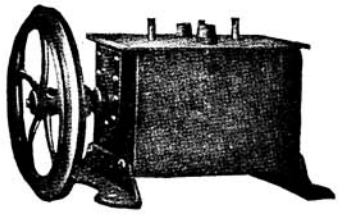
42-45 TORRENTIUM OIL FOR HIGH VACUUM WORK. For the best results with oil-sealed pumps, especially prepared oil having both the right viscosity and vapor tension is required. To meet the requirements of our own Institute Pumps as well as for all oil-sealed pumps, we have arranged to have supplied to us a special oil prepared to meet the most exacting demands of high vacuum work. The price is of necessity somewhat higher than for oils of commercial grade, but the amount required for each pump is so small that the expense is nominal. .....Per quart **1.50**

LOW PRESSURE
ROTARY AIR COMPRESSORS OR VACUUM PUMPS

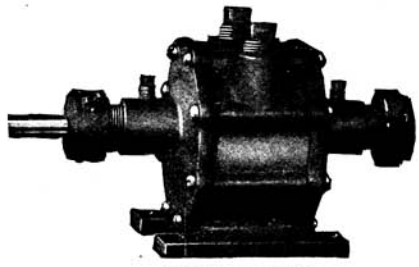
Designed for a working pressure of 25 lbs. to the square inch; used as a vacuum pump, will exhaust to a vacuum of from 29 to 30 inches (mercury column). Continuous intake and delivery of air.



No. 42–110



(In Oil Immersion Box)
No. 42–140



(Without Oil Box)
No. 42–140

42–110 ——, speed 500 R.P.M., requiring ¾ H.P. Capacity 4.3 cubic feet per minute or 15 cubic inches per revolution. Pipe size inlet and outlet, ½-inch. Weight 70 lbs., floor space 13×18 inches. With 6×2-inch tight and loose pulleys **$90.00**

42–110A ——, speed 400 R.P.M., requiring 1 H.P. Capacity 9.2 cubic feet per minute or 40 cubic inches per revolution. Pipe size inlet and outlet ¾-inch. Weight 115 lbs.; floor space 14×22 inches. With 8×2-inch tight and loose pulleys **115.00**

42–110B ——, speed 300 R.P.M., requiring 2 H.P. Capacity 17 cubic feet per minute or 100 cubic inches per revolution. Pipe size inlet and outlet, 1-inch. Weight 250 lbs.; floor space 19×34 inches. With 12×4-inch tight and loose pulleys **150.00**

42–130 **HARCOURT HIGH-PRESSURE PORTABLE ELECTRIC COMPRESSED AIR OUTFIT,** D. C. 110 volt, or A. C. 110 volt, 60 cycle circuit. Consists of a self-contained Electric Air Compressor with no exposed electrical or working parts, guaranteed to develop upwards of 80 lbs. pressure without over-heating, and a 5-gallon Storage Tank, mounted on same base. With electric cord and attachment plug, pressure gauges and all necessary cocks. This is an outfit that will meet every laboratory need for compressed air **155.00**

42–140 **ROTARY VACUUM OR PRESSURE PUMP,** same type as **Nos. 42–110** to **42–110B,** but recommended **especially for vacuum work.** Speed 600 R.P.M., requiring ¼ H.P. Capacity 2 cubic feet per minute. Pipe size inlet and outlet, ½ inch. Weight without oil box, 20 lbs.; with oil box, 50 lbs. Floor space (in oil box) 15×8 inches. Fitted in oil box, making the pump practically leak-proof ... **75.00**

42–141 ——, **without oil box** **65.00**

No. 42–130

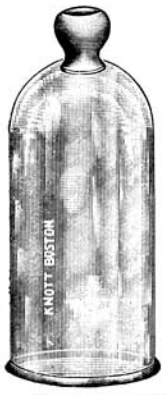
STORAGE TANKS

For storage of air or non-corrosive gases under pressure. Of heavy galvanized iron and guaranteed absolutely air-tight for a working pressure of 100 lbs.

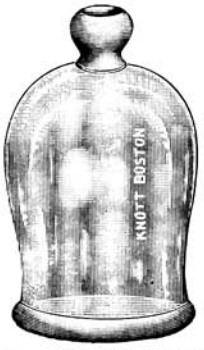
43–110 ——, **capacity 2½ gallons,** 20 inches high, 6 inches diameter **$14.50**

43–111 ——, **capacity 5 gallons,** 20 inches high, 9 inches diameter **18.75**

43–112 ——, **capacity 12 gallons,** 33 inches high, 10 inches diameter **24.00**



Nos. 43–25 to 43–27



Nos. 43–35 to 43–40

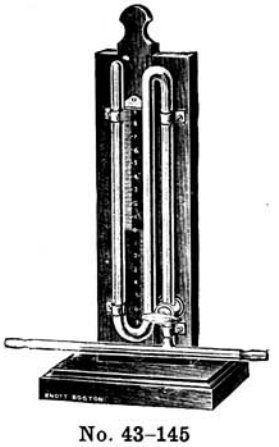
No. 43–140

No. 43–50

No. 43–60

Nos. 43–65 to 43–67

No. 43–70



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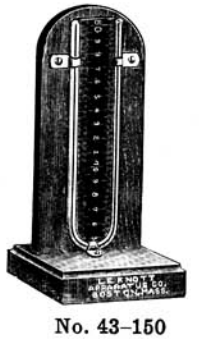

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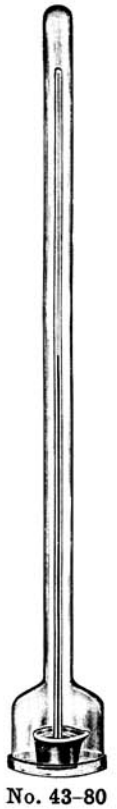


No. 43–80

BELL GLASSES

Clear Glass. Flanges Carefully Ground and Tested

43–25 ——, **Straight Form with Knob Top,** 1 gallon. Measures inside, 11 inches high, 6 inches diameter.. **$3.25**

43–27 ——, 2 gallons. Measures inside 15 inches high, 7 inches diameter..... **4.75**

43–35 ——, **Swelled Form with Knob Top,** 2 gallons. Measures inside 12 inches high, 7 inches diameter. **4.75**

43–37 ——, 3 gallons. Measures inside 13 inches high, 8½ inches diameter..... **6.00**

43–40 ——, 5 gallons, Measures inside 15 inches high, 10 inches diameter..... **14.50**

43–50 ——, **Straight Form with Glass Stopper, 1 gallon.** Measures inside 11 inches high, 6 inches diameter..... **4.75**

43–60 ——, **Straight Form with Neck for Stopper, 1 gallon.** Measures inside 11 inches high, 6½ inches diameter..... **4.50**

43–65 ——, **Low Form with Knob Top.** Measures inside 2¼ inches high, 4 inches diameter..... **1.65**

43–67 ——, measures inside 4 inches high, 6 inches diameter **2.25**

43–70 **HAND AND BLADDER GLASS,** medium size..... **1.65**

43–80 **BAROMETRIC PRESSURE STUDY OUTFIT.** Consists of **No. 43–82** Bell Glass, **No. 41–155** Barometer Tube and **No. 41–160** Mercury Well, complete as illustrated..... **10.70**

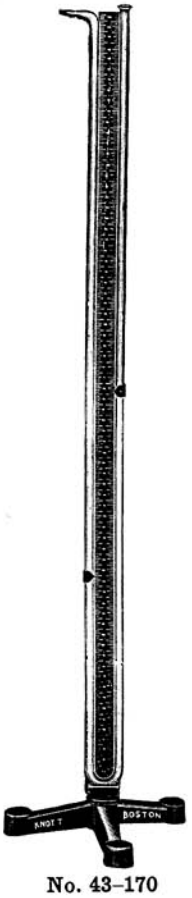
43–82 **BAROMETRIC PRESSURE STUDY BELL GLASS,** 3 feet high, shaped as illustrated (see illustration **No. 43–80**) lower part measures inside 4¾ inches, upper part 1¼ inches diameter **9.50**

MANOMETERS

43–140 **MANOMETER** for attachment to air pump to show degree of exhaustion. The metal casting is threaded to fit any hole threaded 7/16×16. A black oxidized scale filled in white holds the manometer tube..... **$14.00**

43–145 **MOVABLE SCALE MANOMETER** for general use in study of phenomena in pneumatics. Mirror scale graduated above and below zero line. Filled with mercury and mounted as illustrated. With directions for use..... **18.00**

43–150 **SIMPLE MANOMETER.** U-tube filled with mercury and mounted on simple stand with scale... **2.75**



No. 43–170

No. 43–247

No. 43–245

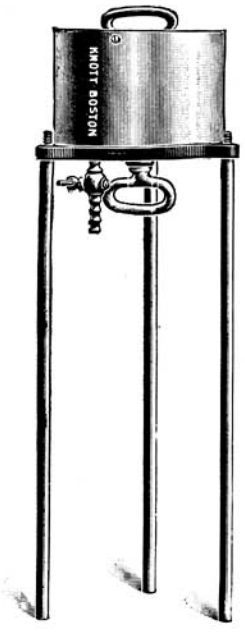
No. 43–240

No. 43–200

No. 43–202

No. 43–204

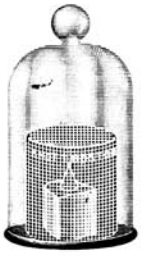
43–160	**JAR WITH TWO MANOMETER TUBES, INLET TUBE AND PINCHCOCK.** (See Millikan, Gale & Bishop, Exp. 5)	**$1.50**
43–161	**MANOMETER TUBE** as used in above	**.40**
43–165	**BALANCING COLUMNS TUBE.** (See Millikan, Gale & Bishop, Exp. 5)	**1.65**
41–114	**MILLER'S COMBINATION PRESSURE TUBE** for use on **No. 41–116** Adjustable Scale Support. A U-tube, one meter long, with one arm open and the other terminating in an air-tight stopcock. In use as a pressure tube, stopcock is left open; as a barometer tube, the stopcock is left open until the tube has been filled with mercury, then it is closed; as a Boyle's Law tube, the stopcock is left closed	**3.50**
43–170	**PRESSURE GAUGE** (see National Physics Direction Sheets, Exp. M260). Mounted as illustrated on Adjustable Scale Support **No. 41–116**	**6.40**
43–171	**PRESSURE GAUGE,** tube only of **No. 43–170**	**1.80**
43–200	**BRASS COUPLING,** threaded $\frac{7}{16}\times16$, to fit all our air pumps and accessories	**.85**
43–202	**BRASS STOPCOCK,** $\frac{1}{8}$-inch bore, threaded $\frac{7}{16}\times16$, to fit all our air pumps and accessories	**1.25**
43–204	**BRASS NIPPLE,** tapped $\frac{7}{16}\times16$, to fit all our air pumps and accessories	**.85**
43–210	**PUMP OIL AND CAN,** 4 oz. best lubricating oil in screw stoppered-can	**.35**
43–215	**PHOSPHORUS PENTOXIDE** for absorption of moisture in high vacuum experiments. ....Ounce	**.75**
43–217	**VACUUM TUBING,** heavy-walled re-inforced rubber tubing, $\frac{5}{16}$-inch diameter. .....Foot	**.28**
43–220	**RUBBER DAM or THIN RUBBER SHEETING.** .....Square foot	**.40**
43–221	**VEGETABLE PARCHMENT,** best quality. .....Sheet	**.25**
43–225	**LEATHER WASHERS,** $\frac{3}{4}$-inch diameter, $\frac{7}{16}$-inch hole. .....Dozen	**.25**
43–230	**RUBBER BAG** for experiments in pneumatics, pure gum rubber of light weight with outlet tube. Complete with pinchcock	**1.65**
43–240	**FOUNTAIN-IN-VACUO,** illustrating atmospheric pressure. When globe is evacuated of air and open end placed under water, atmospheric pressure will drive the water with considerable force up into the globe as soon as the stopcock is opened. With tripod support	**10.50**
43–245	**DEMONSTRATION 16-INCH WATER HAMMER or FOUNTAIN-IN-VACUO** for illustrating atmospheric pressure or for showing that a liquid will fall as a solid in a vacuum	**6.15**
43–247	**WATER HAMMER** for showing that a liquid will fall as a solid in a vacuum. Length, 30 cms.	**1.50**



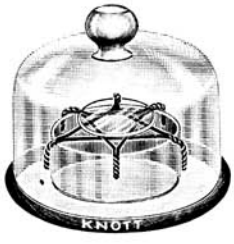
No. 34–40

No. 43–270

No. 43–255



Nos. 43–276 and 43–277



No. 43–310

No. 43–290

43–255 **MAGDEBURG HEMISPHERES** for demonstrating atmospheric pressure on all sides of a body. Two cast hollow hemispheres, edges ground smooth for an air-tight junction. Stopcock threaded 7/16×16 to fit our air pumps. With special tripod as illustrated **$8.25**

34–40 **SEVEN-IN-ONE APPARATUS OR SPIROMETER** for demonstrating fundamental principles in pneumatics and hydraulics. The cylinder is seamless brass, 6 inches in diameter. Rods may be screwed in from either side of the metal cap casting. Handle in piston head is detachable. This design will illustrate principles involved in seven different instruments: Hydraulic Lift, Hydraulic Press, Incompressibility of Liquids Apparatus, Pascal's Law Apparatus, Pneumatic Lift, Hydrostatic Bellows, and Magdeburg Hemispheres **18.50**

43–270 **MODEL OF A DIVING BELL,** demonstrating how, in a caisson, air is supplied to keep up life and to keep back the water. The conical-shaped glass vessel with metal mountings at top and bottom, has, at its top, a tube for supply of air which is pumped into the vessel by means of an air pump. The bottom casting is designed to hold a slow match and to support a weight. The whole is supported, by any convenient means, submerged in a jar of water. Without support of any kind, but otherwise complete as illustrated **8.75**

43–276 **BURSTING SQUARES** to illustrate the expansion of air when outside pressure is removed. Without bell glass or wire guard. .....Per dozen **3.00**

43–277 **WIRE GUARD** to protect bell glass from flying broken parts of the bursting square ..... **.80**

43–286 **BELL-IN-VACUO** for illustrating non-transmission of sound in a vacuum. The bell is mounted on a flexible handle so that its vibrations are not transmitted to the bottle. Stopcock threaded 7/16×16 to fit our air pumps **4.25**

43–290 **MOUNTED ELECTRIC BELL** for use under a bell glass on our **No. 42–15** Air Pump to illustrate non-transmission of sound in a vacuum **3.20**

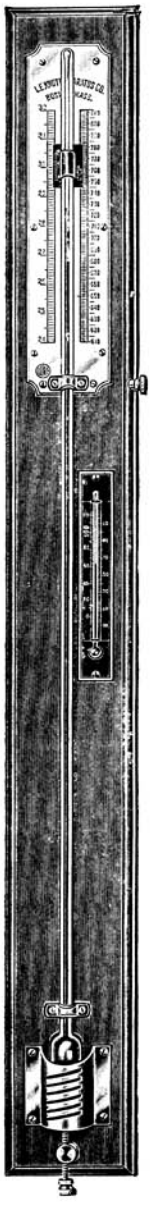
40–22 **COMBINED BAROSCOPE GLOBE and BELL-IN-VACUO** for use as a **Baroscope Globe** in determining weight of air, or as a **Bell-in-Vacuo** in illustrating non-transmission of sound in a vacuum. The globe is of glass, 4¼ inches diameter (for illustration, see page 72) **7.85**

43–310 **FREEZING APPARATUS** illustrating freezing by the rapid evaporation of ether or other volatile liquid. Complete as illustrated **2.75**

BAROMETERS

Atmospheric and Air Pressure, Heat, Humidity Indicators, Etc.

The value of the Weather Bureau Type of Barometer has been realized in no small degree because of the large reservoir in which the height of the mercury is adjusted by means of the screw plunger at the bottom, the correct zero being indicated by a pearl white pointer projecting downward towards the surface of the mercury. This indicator being fixed, and the scale rigidly attached with reference to it, the level of the mercury is readily brought to the correct zero point before each reading. Many other methods of adjustment have been devised, but none has even approached this for accuracy and ease of operation.



No. 45–15

45–10 KNOTT'S IMPROVED FORTIN CISTERN MERCURIAL SCHOOL BAROMETER for use in altitudes up to 6500 feet. In the design of this, our new barometer, we have followed the construction universally approved in the Weather Bureau types. The cistern is large and the height of mercury is adjusted by means of a plunger at the bottom, the correct zero being indicated by a fixed colored-glass pointer projecting downward toward the surface of the mercury.

The **Scale** is graduated in both English and Metric systems, reading from 24 to 32 inches by 0.1 inch, with equivalent range in Metric system by millimeter divisions. Silvered scale with black filled divisions and figures.

The **Tube** is of generous proportions and filled with the greatest care.

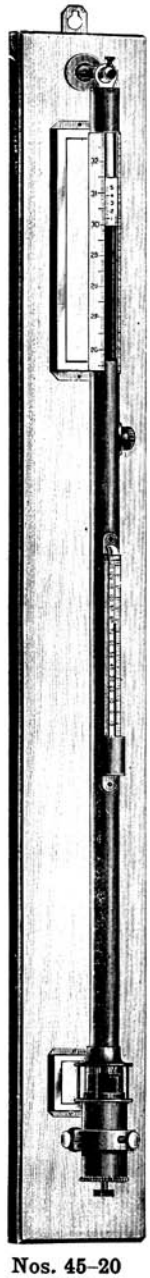
The **Mounting** is of well-seasoned hardwood, rubbed finish. All metal parts are well made, black-oxidize and nickel-plate finish. The protecting cap for reservoir is designed to permit clear view of both indicator and mercury in the reservoir..... **$18.50**

45–15 KNOTT'S IMPROVED FORTIN CISTERN MERCURIAL SCHOOL BAROMETER WITH VERNIER ADJUSTMENT, same as **No. 45–10,** but **with double vernier** reading to 0.1 mm. or 0.01 inch. Vernier movement positive in action and easily operated by knurled thumb screw shown in the illustration..... **27.50**

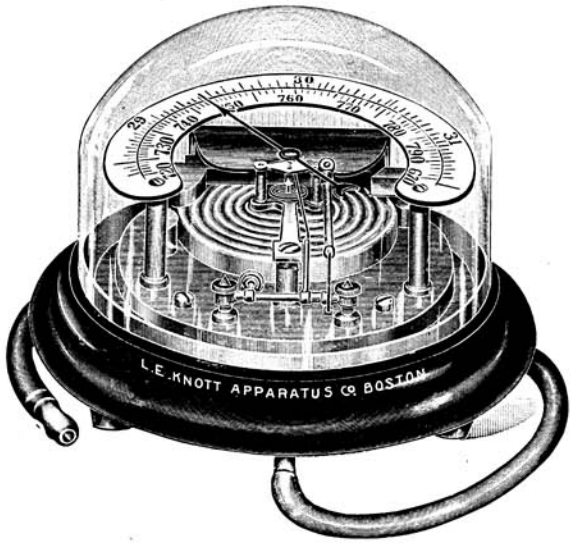
45–20 STANDARD WEATHER BUREAU FORTIN CISTERN MERCURIAL BAROMETER for altitudes up to 5000 feet. This type of barometer has become the most popular type where great accuracy is required. The mercury tube is enclosed in a brass body with gun metal finish. All working parts are well made and protected as far as practicable. The scale is in both Metric and English systems, reading from 25½ to 32½ inches, with equivalent range in the Metric system. The vernier is operated by the knurled thumb screw shown in the illustration. It is divided on one side to read to 0.002 inch and on the other to 0.1 mm.

Barometer only, without mounting board..... **65.00**

45–25 BAROMETER MOUNTING BOARD for use as a support for standard barometers. A finely finished hardwood back on which are attached the suspension bracket, white opaque glass reflectors, etc., to facilitate suspension, leveling, and reading..... **9.50**



Nos. 45–20 and 45–25



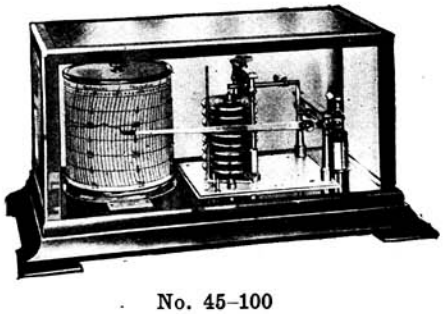
No. 45–30

No. 45–40

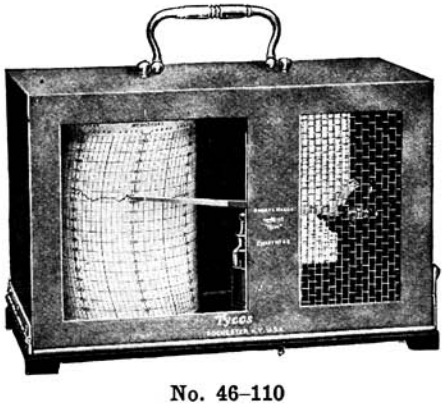
45–30 **DEMONSTRATION ANEROID BAROMETER,** for illustration and demonstration of the working mechanism of an Aneroid Barometer. All working parts visible through a glass dome. Air pressure, varied in vacuum chamber through the rubber tubing. Accurate barometric observations possible. **$27.50**

45–40 **ANEROID BAROMETER, Metric and English graduations,** 4 inches diameter, adjusted for altitudes up to 5500 feet. Highly polished brass case, dial open so that mechanism may be clearly seen **8.50**

BAROGRAPHS — THERMOGRAPHS



No. 45–100



No. 46–110

45–100 **IMPROVED RECORDING BAROMETER (BAROGRAPH).** Records upon a chart all atmospheric changes in pressure, and time such changes occur. Records for one week without change of chart. Enables one to make weather forecasts; serves as an accurate barometer. Consists essentially of a " pile " or series of vacuum chambers secured above and below one to the other. Any change in pressure is greatly magnified by this series of chambers and further magnified by a system of levers connected to the arm which carries the recording pen. This pen makes a permanent hourly and daily record on the chart attached to a drum which revolves by clock work, one complete turn in seven days. Enclosed in glass-paneled polished mahogany case, with one year's supply of charts, bottle of ink, etc. **$55.00**

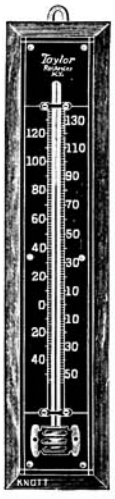
45–102 **BAROGRAPH CHARTS** for use with above. One year's supply in a box **3.00**

46–110 **RECORDING THERMOMETER (THERMOGRAPH).** An instrument arranged to record upon a chart a continuous 7-day record of temperature. The arm carrying the recording pen is connected directly with a coil which changes as the temperature rises or falls. This pen makes a permanent hourly and daily record on the chart attached to a drum which revolves by clock work, one complete turn in seven days. Enclosed in non-corrosive metal case with glass windows, with one year's supply of charts (—10 to 90° F.), bottle of ink, etc. **55.00**

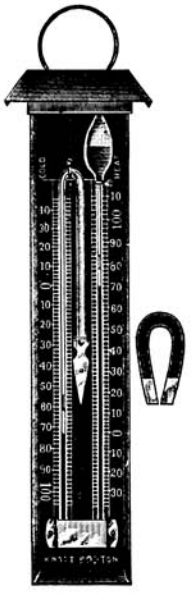
46–112 **THERMOGRAPH CHARTS** for use with above. One year's supply in a box **3.00**

METEOROLOGICAL THERMOMETERS

No. 63–10



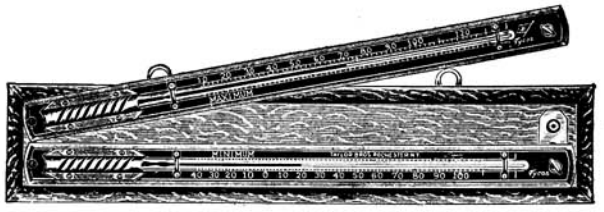
No. 63–12



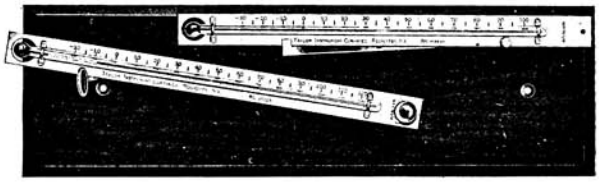
No. 46–35

No. 46–70

No. 46–30



No. 46–40



No. 46–52

63–10 HOUSEHOLD THERMOMETER, -30 to 120° F., 8-inch, metal frame, metal scale with white figures and graduations..... **$1.50**

63–12 HOUSEHOLD THERMOMETER, -30 to 120° F., 10-inch, metal scale with white filled figures and graduations; on hardwood back; magnifying mercury-filled tube..... **1.75**

46–30 WEATHER BUREAU PATTERN THERMOMETER WITH CERTIFICATE, -40 to 120° F., mercury-filled tube on engraved metal scale mounted on insulating brass support with binding screws. **8.25**

46–35 SIX'S MAXIMUM AND MINIMUM SELF-REGISTERING THERMOMETER, japanned metal case, hardwood scale, with filled figures and graduations. With magnet in carton..... **7.50**

46–40 MAXIMUM AND MINIMUM THERMOMETERS. Magnifying tubes, each on graduated metal back, and adjustably mounted on hardwood board..... **7.50**

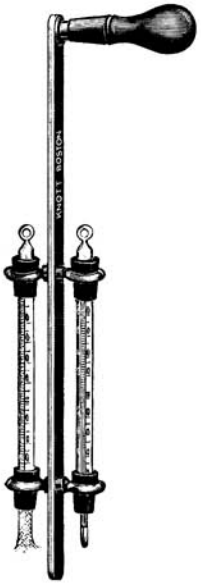
46–50 WEATHER BUREAU SELF-REGISTERING MAXIMUM THERMOMETER with certificate. Magnifying tube on engraved metal scale, mounted on insulating brass support with binding screws. In box..... **8.25**

46–51 WEATHER BUREAU SELF-REGISTERING MINIMUM THERMOMETER, with certificate. Magnifying tube on engraved metal scale, mounted on insulating brass support with binding screws. In box..... **8.25**

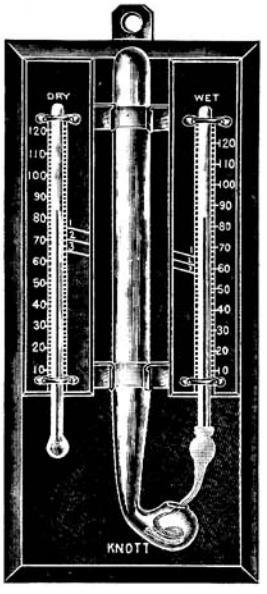
46–52 WEATHER BUREAU SELF-REGISTERING MAXIMUM AND MINIMUM THERMOMETERS with certificates. Consists of **Nos. 46–50** and **46–51,** appropriately mounted on polished wood board. In box..... **18.75**

46–70 SOIL THERMOMETER, 16 inch, range approximately +30 to 180° F. Wood frame, with handle; brass pointed ferrule..... **3.00**

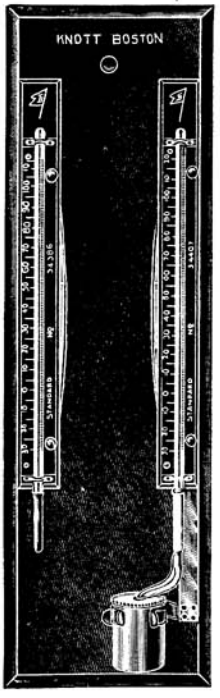
HUMIDITY INDICATORS



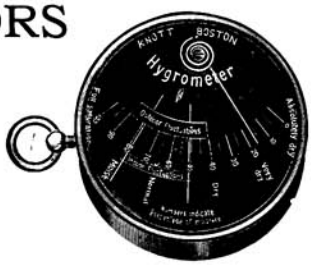
No. 47–10



No. 47–15



No. 47–20



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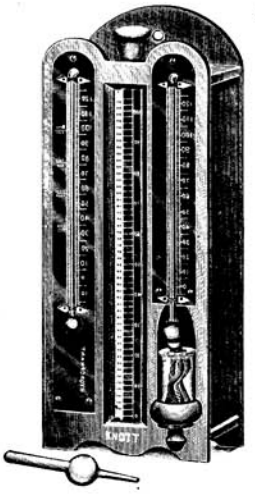
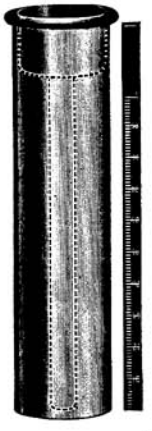


No. 47–40



No. 47–65

47–10 **"SLING" PSYCHROMETER** for determining humidity more rapidly and accurately than possible with the stationary wet and dry bulb instruments. The handle is swiveled to metal strip carrying the thermometers..... **$7.50**

47–15 **MASON'S HYGROMETER (Wet and Dry Bulb)** for determining the relative and absolute humidity and dew point. Magnifying mercury-filled tubes on black oxidized brass scales. On polished hardwood back..... **5.75**

47–20 **WEATHER BUREAU PATTERN HYGROMETER (Wet and Dry Bulb).** Two thermometers (**No. 46–30**) mounted as illustrated with nickel-plated brass cistern on polished wood back..... **18.00**

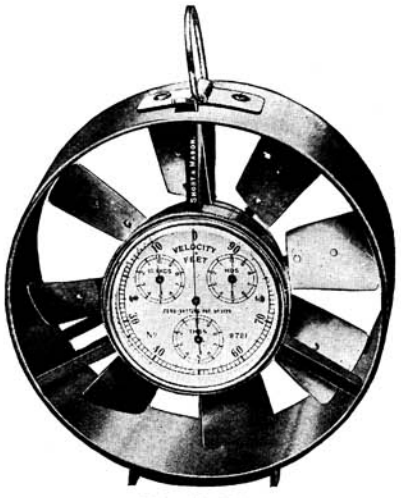
47–25 **SPIRAL HYGROMETER** for readings of humidity of the air without reference to tables. Nickel-plated case..... **3.25**

47–40 **DIRECT READING HUMIDITY APPARATUS (HYGROPHANT)** for determining without computation both temperature and humidity of the air. Relative humidity or percentage of moisture is read directly from the cylinder noted between the two thermometers. This is a well-made instrument capable of highest degree of accuracy. With full and detailed directions for use..... **16.50**

47–65 **RAIN GAUGE, United States Weather Bureau Type,** 13 inches high, 3 inches diameter. With overflow and measuring stick..... **4.25**

ANEMOMETERS

No. 48–12



No. 48–17

For registering pressure and velocity of air currents in mines, tunnels, sewers, and the ventilators of hospitals, schools, and other public buildings. The indications are obtained by means of a delicately-poised fan wheel, the recording beginning with the long hand which indicates 100 feet in one complete turn about the main dial. The enumeration is continued by a series of smaller dials.

A disconnector, projecting from the band of the instrument opposite the fly wheel, serves to throw the mechanism out of gear and arrests its action when required.

48–12 ——, **four dials reading to 100,000 feet.** For pressures up to 3000 feet per minute..... **$48.75**

48–15 ——, **BIRAM'S, two dials reading to 1000 feet.** For pressures up to 1000 feet per minute..... **45.00**

48–17 ——, **BIRAM'S four dials reading to 100,000 feet.** For pressures up to 3000 feet per minute..... **47.50**

No. 48–100

HARCOURT STUDENTS' METEOROLOGICAL EQUIPMENT

A complete set of meteorological instruments of standard quality in shelter. Consists of:

63–12 Wood-back Thermometer.

46–40 M. & M. Thermometers.

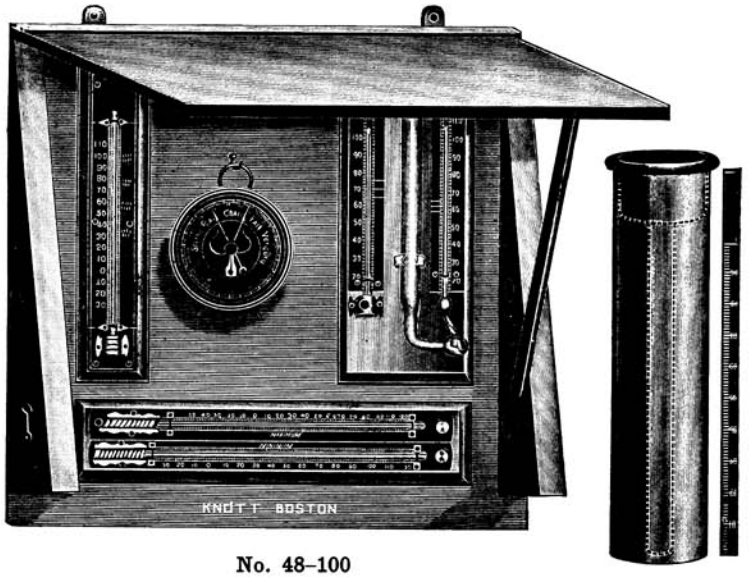
47–15 Mason's Hygrometer.

45–40 Aneroid Barometer.

47–65 Rain Gauge.

48–105 Instrument Shelter.

Price, $38.50



No. 48–100

48–102 ——, **without No. 47–65 Rain Gauge**..... **34.25**

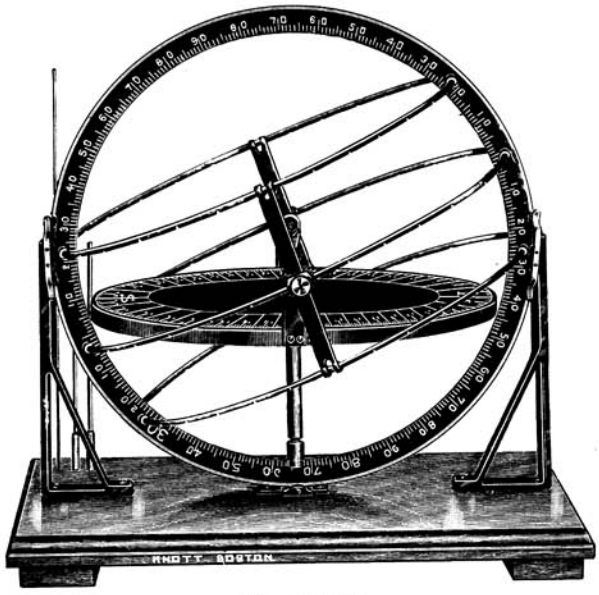
48–105 **INSTRUMENT SHELTER** as illustrated above. Substantial structure throughout, painted inside and outside with two coats best lead paint. Fitted with hooks for attaching instruments, and bracket for holding the cover open..... **10.75**

B-K SOLAR CALCULATOR

No. 49-120

Invented by FRANK L. BRYANT

ERASMUS HALL HIGH SCHOOL, BROOKLYN, N. Y.



No. 49–120

The object of this ingenious instrument is to provide a simple apparatus for teaching the fundamental ideas of the apparent motion of the sun in relation to any point on the earth's surface and at any time of the year. It is especially designed for the use of students in the laboratory for working out certain problems noted below. It is also of value to the teacher in lecture work for all grades of geography instruction from the grammar school to advanced work in the college.

This instrument, about 16 inches high and 16 inches wide, is especially adapted for the lecture table, although it was primarily designed for individual student use. A special feature in connection with the use of the instrument, and one entirely new, is that the horizon disc may be lowered and adjusted for plotting shadow curves at the time of the solstices and equinoxes for different latitudes. This work was practically impossible before the introduction of the B-K Solar Calculator. Its value, therefore, will be especially appreciated by teachers of Physical Geography.

The following exercises may be performed by the use of the instrument:

1. Find the time of sunrise and sunset at any latitude at any time of the year.
2. Determine the length of day at any latitude at any time of the year.
3. Find the relative distribution of insolation over the earth at different times of year.
4. Find the direction of sunrise and sunset at any latitude at any time of the year.
5. Find the altitude of the sun at any latitude at any time of the day or year.
6. Plot the curves of a shadow cast by an upright post at any latitude at the time of the solstices and equinoxes.
7. Interpretations of shadow curves.
8. Show relation of elevation of celestial pole to latitude.
9. Show relation of zenith distance of sun to latitude at different times of the year.
10. Show relation of length of twilight to latitude at different times of the year.

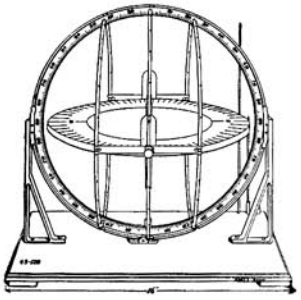
49–120 B-K SOLAR CALCULATOR, brass, with oak base. . . . . Special price in lots of ten. **$42.00**

Directions for use furnished with each instrument.

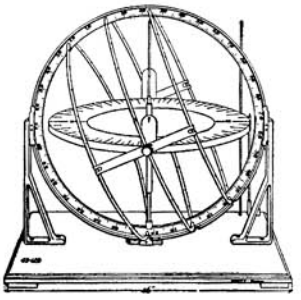
No. 49-120

B-K SOLAR CALCULATOR

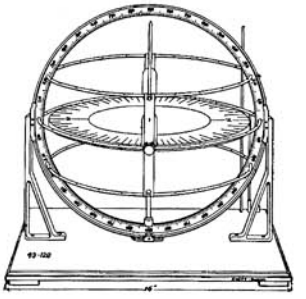
(See preceding page)



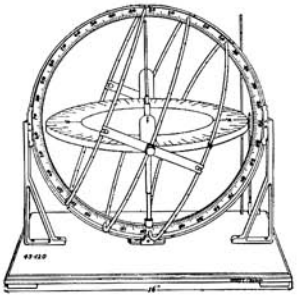
Set for the Equator



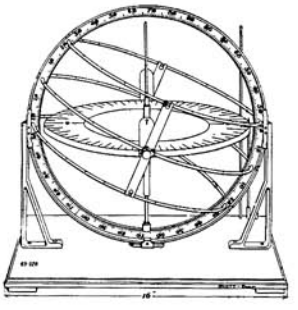
Set for Tropic of Cancer
23½° N. Lat.



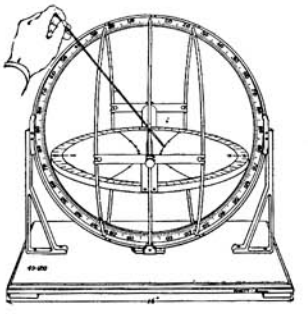
Set for the North Pole, 90°



Set for Tropic of Capricorn
23½° S. Lat.

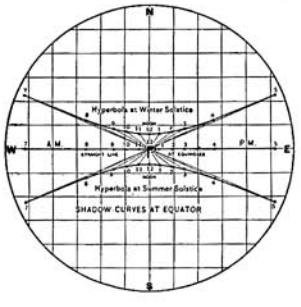


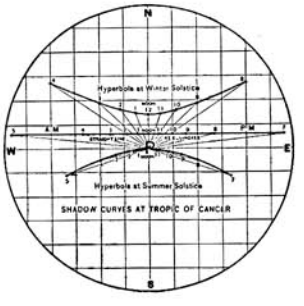
Set for the Arctic Circle
66½° N. Lat.

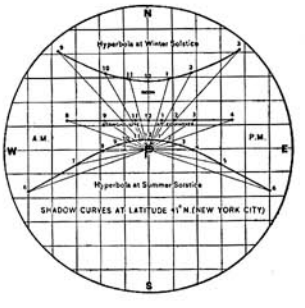


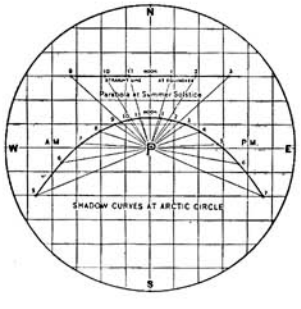
Set for plotting the Shadow Curves at the Equator

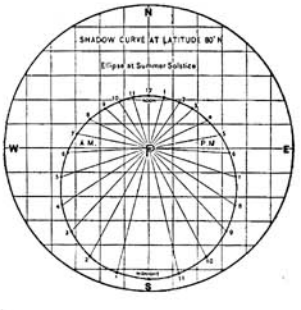
FORMS OF SHADOW CURVES

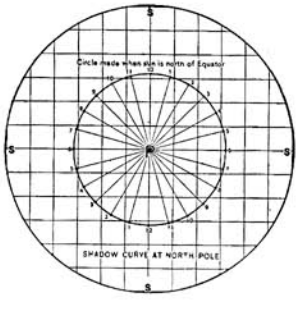






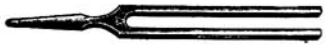






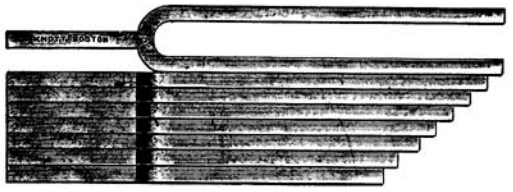
SOUND

PROPAGATION OF SOUND

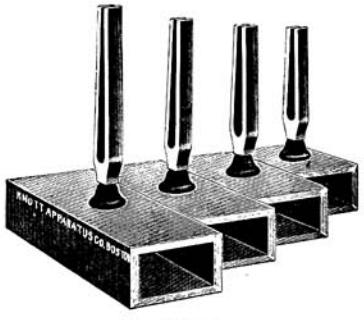


No. 51–55

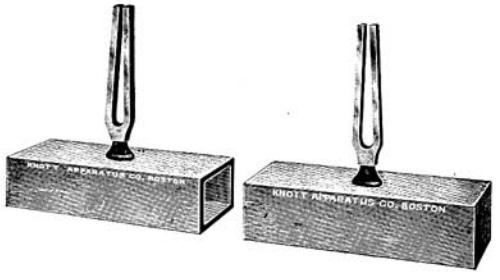
No. 51–50



Nos. 51–75 to 51–82



No. 51–86



No. 51–190

51–50 **UNIVERSAL PATENT ADJUSTABLE TUNING FORK.** By adjusting the slides on the ends, this fork can be tuned to either Concert or International Pitch. The slider between prongs can be adjusted to the key desired **$1.75**

TUNING FORKS

All tuning forks are tuned to the Physical Pitch, and, when a tuning fork is mounted on a resonant case, it must be understood that the case is accurately tuned in resonance with the fork.

	Pitch	V. P. S.	Approximate Length Cms.	Price
51–55	A	426⅔	12	**$0.35**
51–57	C	256	12	**.35**
51–65	C	128	25	**3.85**
51–75	C^1	256	22	**2.75**
51–76	D	288	21	**2.75**
51–77	E	320	20	**2.75**
51–78	F	341⅓	20	**2.75**
51–79	G	384	19	**2.50**
51–80	A	426⅔	19	**2.50**
51–81	B	480	18	**2.50**
51–82	C^2	512	18	**2.50**

51–85 **UNMOUNTED TUNING FORKS, Set of Four,** Major Chord, C^1, E, G, C^2 (**Nos. 51–75, 51–77, 51–79,** and **51–82**) **10.50**

51–86 **MOUNTED TUNING FORKS, Set of Four,** Major Chord, C^1, E, G, C^2, each mounted on a tuned resonant case **24.00**

51–87 **UNMOUNTED TUNING FORKS, Set of Eight,** full octave, C^1 to C^2 (**Nos. 51–75** to **51–82**) **21.00**

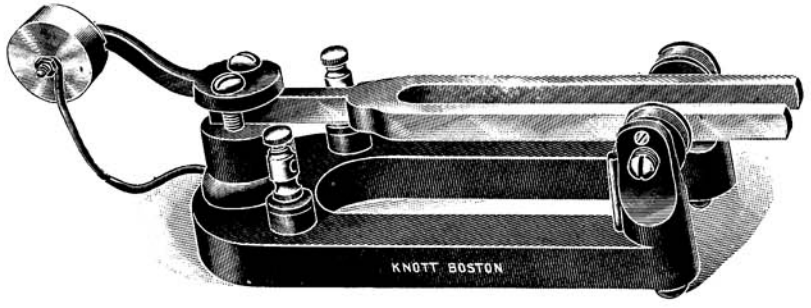
51–88 **RUBBER HAMMER,** small ..... **.25**

51–89 **LECTURE TABLE RUBBER HAMMER,** large, pure gum, polished wood handle **1.10**

51–190 **SYMPATHETIC TUNING FORKS** for showing sympathetic vibrations, also " Beats." Large forks, 256 V. P. S., tuned to unison. With rubber hammer **24.00**

ELECTRO-SYNCHRONISM-DRIVEN RECORDING FORK

Vibration of fork is produced by the varying current in two electro-magnets by means of a carbon button as used in telephone transmitters



Nos. 51–135 to 51–140

The nearest approach to an ideal electrically-driven tuning fork has been reached in our electro-synchronism tuning fork. The improvements that we have made on the original designs make possible many experiments previously impossible with electrically-driven tuning forks. The basic improvement consists of an especially-designed microphone mounted in the base of the instrument. This microphone picks up the vibrations thrown from the fork, and in turn varies the strength of the electro-magnets which actuate the fork, leaving the prongs **free to vibrate unhampered by contacts or springs** such as were formerly used. In use the binding posts are connected to the source of current, 4 cells of dry battery being recommended.

The synchronism that takes place is shown in a very striking manner. Starting with an almost imperceptible vibration, the fork gradually reaches its highest amplitude, when it will continue to give forth a tone of great purity, with absolute freedom from all other foreign sounds or vibrations which have proved so troublesome in forks constructed by ordinary methods. The synchronism method insures the fork giving its actual tone, a result not obtained by any other method.

Electrically-driven tuning forks in which the electric contact is made directly on the prongs either by a spring attached to one prong or by a platinum contact soldered to it, have the following objections:

1. The prong of the fork carrying the contact or spring is dampened, and the fundamental tone of the fork is radically changed thereby.
2. The vibration of the fork is forced to an unnatural pitch by means of the sudden rush of current due to its intermittent contact.
3. The contact point emits a sound often sufficient to obscure the fundamental tone of the fork.
4. An adjustment that will give the natural, clear tone of the fork is impossible, owing to the unavoidable noise due to this method of vibration.

In the Electro-Synchronism-Driven Tuning Fork we justly claim the following features:

1. **The fork has nothing to carry.**
2. **The vibration is absolutely dependent upon the natural period of the fork.**
3. **There are no parts of the apparatus to take up vibrations and give any undesirable sounds.**
4. **The fork is actuated by a current that varies in strength from maximum to minimum in absolute synchronism with its own period.**
5. **The vibrating apparatus is absolutely distinct and unattached to the fork and hence produces no distortion in vibration.**

As the principal object of this apparatus is to maintain for a considerable period a uniform tone and vibration coming from a fork having a definite vibration period, we list the apparatus designed for adjusted forks of 128 and 256 vibrations.

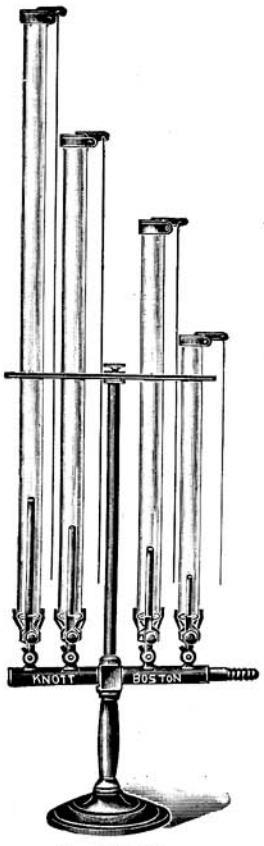
51–135 **ELECTRO-SYNCHRONISM-DRIVEN RECORDING FORK,** including base and large fork accurately adjusted to 128 V. P. S. **$35.00**

51–137 ——, same as above, but with fork accurately adjusted to 256 V. P. S. **22.00**

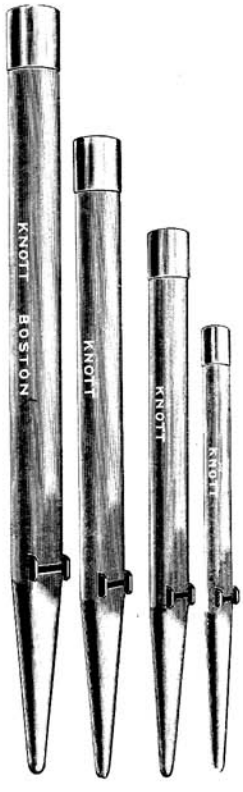
51–140 **UNADJUSTED TUNING FORK, large size,** for use with **No. 51–135.** It is frequently desirable to use an electrically-driven tuning fork designed so that the stylus for recording the vibrations on a moving surface may be attached; also one in which the mirrors for use in tracing Lissajous' figures may be used. Where these attachments are added the absolute vibration of the fork cannot, of course, be depended upon, since the prong must carry a load. For this work, therefore, a fork which has not been especially adjusted is entirely adequate. The fork which we furnish under this number is one of unusually substantial construction, approximately 15 inches long, giving about 100 vibrations per second and supplied with threaded holes on the ends of the fork for carrying binding screws which hold the recording stylus, also for carrying the mirrors listed below, used in Lissajous' experiments. Complete with stylus **12.75**

51–141 ——, **small size,** for use on **No. 51–137** **5.75**

51–142 **MOUNTED MIRRORS FOR LISSAJOUS' CURVES** supplied with threaded stems fitting the holes of the fork **No. 51–140.** ..... Per pair **2.50**



No. 51–212



No. 51–275

No. 51–240

No. 51–290

No. 51–295

51–210 **SINGING FLAME TUBE AND BURNER.** A simple single-jet burner with glass resonant tube. **$6.00**

51–212 **CHEMICAL HARMONICON.** Four jet burners connected as illustrated, each with resonant glass tube with metal cap. Will sound the major chord. Complete as illustrated..... **30.00**

51–240 **GALTON'S WHISTLE** for determining the highest limit of audibility. Length of air column in the whistle, adjustable and measurable to 1/10 mm..... **13.00**

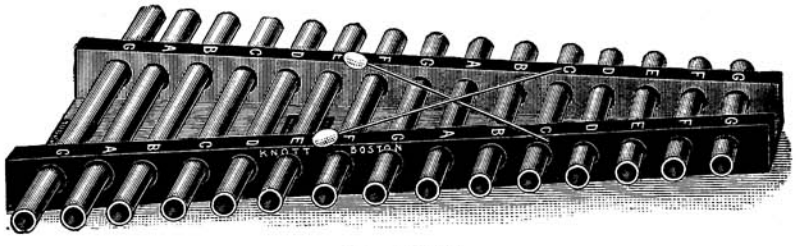
51–250 **GLASS WHISTLE WITH SLIDING PISTON** for determining the "fundamentals" of closed pipes. The air tube is adjustable..... **1.90**

51–275 **ALL METAL ORGAN PIPES WITH SLIDING TUNING TUBES, set of four** metal organ pipes accurately tuned to sound the major chord, C^1, E, G, C^2.....Set **17.00**

51–285 **——, set of eight,** accurately tuned to sound the octave, C^1 to C^2.....Set **27.00**

51–290 **DEMONSTRATION ORGAN PIPE** for showing the vibrating segments and nodes of an organ pipe. A membrane carrying cork dust is adjustable within the organ pipe. Positions of nodes and vibrating segments are visible through the glass window..... **8.00**

51–295 **DEMONSTRATION ORGAN PIPE WITH MOVABLE STOP** for sounding two octaves. Tones and semi-tones distinctly marked on the frame which operates the stop..... **8.00**



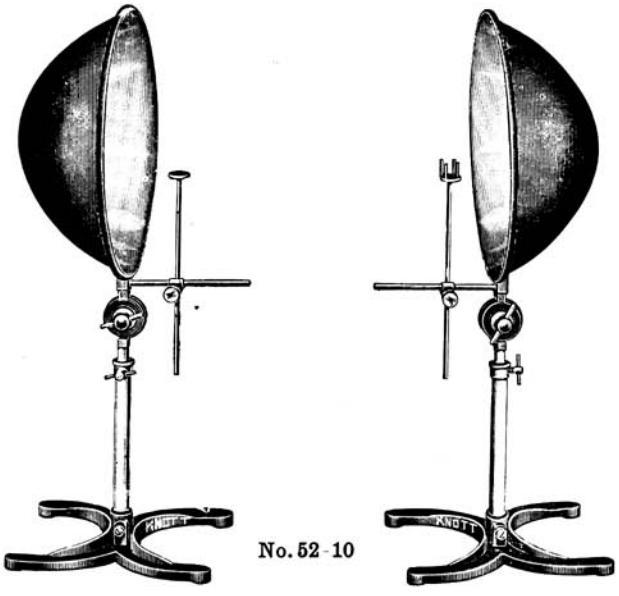
No. 51–325

51–315 **XYLOPHONE** for showing musical tones from vibrating wooden bars. Will sound two octaves. With two hammers..... **3.50**

51–320 **METALAPHONE** for showing musical tones from vibrating metal bars. Will sound one and one-half octave. With two hammers..... **3.00**

51–325 **TUBEPHONE** for showing musical tones from vibrating metal tubes. Will sound two octaves. With two hammers..... **4.00**

REFLECTION — REFRACTION



No. 52-10

52–10 THIRTEEN-INCH UNIVERSALLY ADJUSTABLE TRUE PARABOLIC REFLECTORS for showing reflection of sound, heat, and light waves.

Important Features

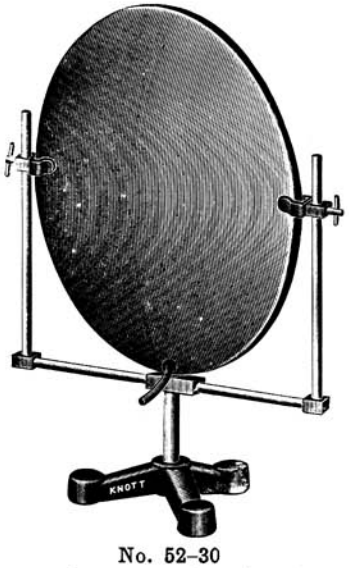
13-Inch True Parabolic Surfaces, the curve for which was mathematically calculated and drawn, and then, by painstaking processes, a chuck turned to conform to this curve.

Mounting of Reflectors. Our reflectors are all heavily reinforced at the rims, and supported and clamped to these rims by a special metal casting in such a way as to entirely obviate any danger of distorting the surfaces.

Adjustments. Especial attention has been given to the design of the adjustable features. The reflectors can be tilted and focused to any angle or in any direction. The height above table is adjustable within the length of the telescoping rod. Universal movement is provided for each object-carrier.

Complete as illustrated with object-carriers **$34.00**

52–15 ——, without object-carriers **29.00**



No. 52–30

52–30 MOUNTED SOUND LENS for experiments on the refraction of sound. The lens is a double-walled, rubber diaphragm vulcanized over a rolled-metal ring. An outlet is provided through which gas may be introduced to inflate the lens to curvature (focus) desired. The stand, differing somewhat from the illustration, gives ample adjustment and full range in the angle of inclination.

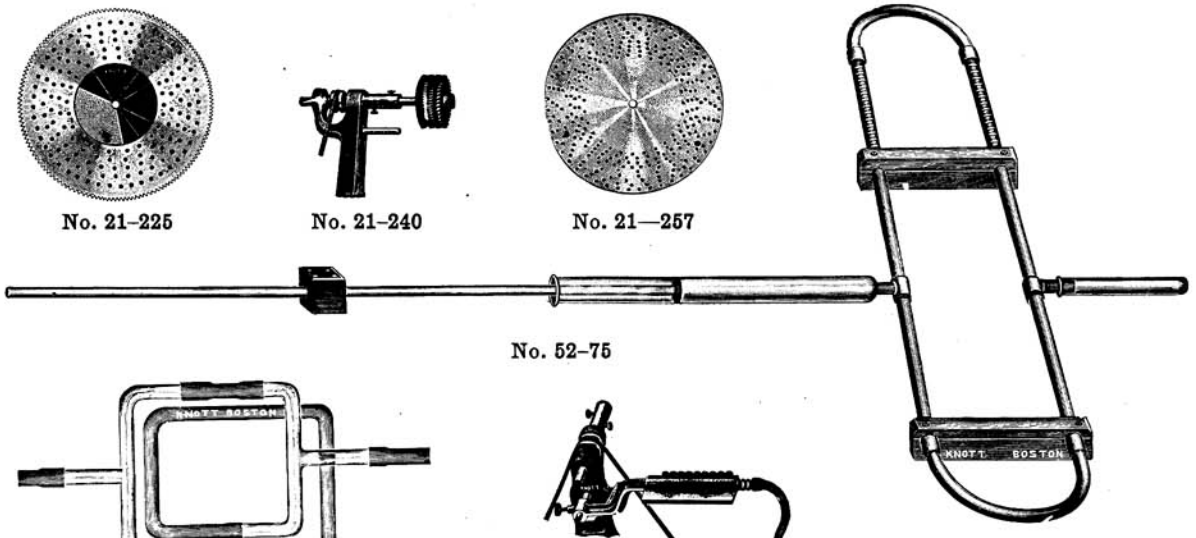
Stand and Lens, complete **16.50**

INTERFERENCE AND FREQUENCY

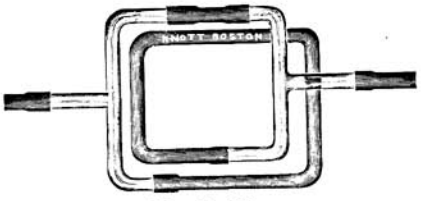
No. 21-225

No. 21-240

No. 21—257



No. 52-75



No. 52-80

No. 21-267

52-75 **KUNDT'S INTERFERENCE APPARATUS** for the quantitative study of interference of sound waves. This apparatus consists of two U-shaped nickel-plated brass tubes, one provided with supporting cross bars; the other with both arms graduated, telescoping into the first. To one of the parallel sides of this interference tube is attached a closed glass tube which in use contains cork dust or lycopodium powder. To the other side is attached a glass tube with supported sliding piston. In use, vibrations are set up in the piston tube with the movable telescoping part of the interference tube pushed home. When the telescoping part of the interference tube is drawn out so that it represents 1, 2, 3, 4, 5, etc., quarter wave lengths figures are produced with the even numbers and are not formed with the odd numbers of quarter wave lengths..... **$35.00**

52-80 **QUINCKE'S INTERFERENCE TUBES** for use with a tuning fork $C^2=256$ V.P.S., in illustrating interference of sound waves. Two T-shaped tubes of same diameter connected by rubber tubing as illustrated..... **2.00**

MEASUREMENT OF NUMBER OF VIBRATIONS

21-225 **COMBINATION NEWTON'S COLOR DISC, SIREN DISC AND SAVART'S WHEEL** for showing that white light results when certain percentages of primary colors are exposed and rotated rapidly. Illustrates also the propagation of sound by mechanical disturbances which cause vibration in the surrounding media. The disc is perforated with four rows of holes equally spaced, and one row unequally spaced; the teeth are equally spaced..... **$3.65**

21-240 **SAVART'S TOOTHED WHEELS** for demonstrating that musical tones are produced by regular impulses imparted to the surrounding media. Each of the four discs has teeth equally spaced..... **3.25**

21-242 **SAVART'S TOOTHED WHEEL,** one wheel same as above, arranged to attach to rotator..... **1.50**

21-255 **METAL SIREN DISC, five rows of holes,** illustrating propagation of sound by impulses imparted to the surrounding media. Four rows of holes equally spaced produce musical notes; one row, unequally spaced produces a noise. **2.50**

21-257 **——, nine rows of holes.** Eight rows, equally spaced produce musical notes; one row, unequally spaced produces a noise..... **2.95**

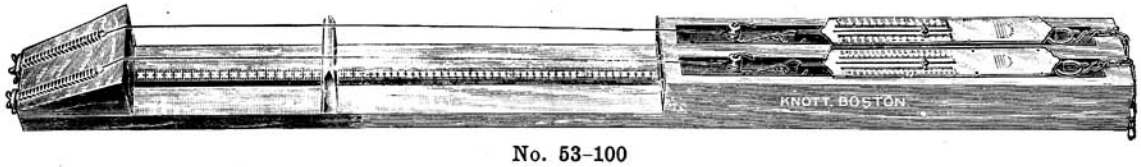
21-267 **AIR IMPULSE ATTACHMENT** for use with Siren Discs **Nos. 21-225, 21-255** and **21-257,** for directing one, two or more (up to nine) steady currents of air, as furnished by blower, against the perforations. Each of the nine air valves is operated by a thumb screw..... **5.25**

53-40 **CAIGNARD-LATOUR SIREN WITH COUNTERS** for determining the pitch or number of vibrations of a body per second. Oxidized or lacquered brass throughout; silvered brass dials. One dial reads number of turns of rotating disc, the other the number of hundreds of turns up to five thousand. Rotating disc has twelve equally spaced holes..... **45.00**

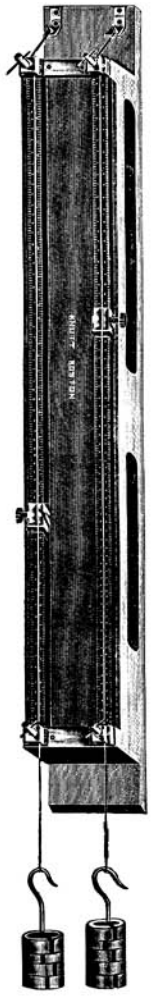
No. 53-40

SONOMETERS

Our sonometers are made from selected well-seasoned wood very carefully glued-up and finely finished. We list below only those designs which in actual use have given the most efficient service. Each sonometer is supplied with wires and necessary bridges. On each case beneath the wires, there is a metric scale on which is indicated also the lengths of strings necessary to give both the diatonic and the equally tempered scale between C=256 VPS. and C=1024 VPS.



No. 53–100



53–100 **SONOMETER.** This sonometer is complete as illustrated, requiring no accessory weights, scale pans, etc. Tension is caused by dynamometers, fine adjustment of tension secured by turning the wing-nuts at the end of the slow-motion screws to which the wires are attached. Length 1½ meters over all. Complete as illustrated..... **$17.50**

53–101 ——, without dynamometers..... **10.50**

53–102 **SONOMETER WIRES,** set of three wires as used on above. .....Set **.40**

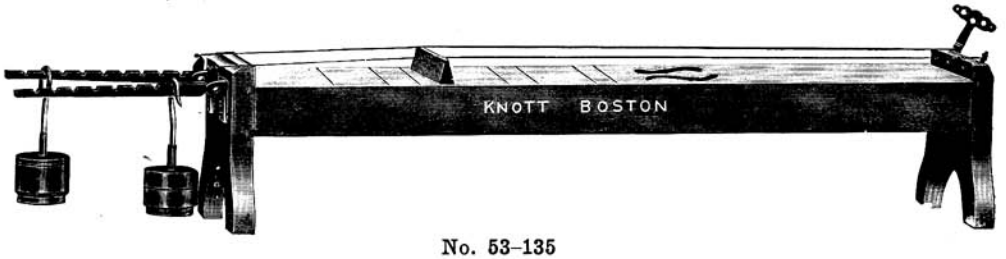
No. 53–115

53–115 **NATIONAL THREE-WIRE SCHOOL SONOMETER** (see National Physics Direction Sheets, Exp. S040). Requires no accessory weights, scale pans, etc. Three wires attached, each with tension spring of 25-lb. capacity. Fine adjustment of tension secured by piano-tension keys..... **7.75**

53–117 **SONOMETER WIRES,** set of three as used on above. .....Set **.40**

53–125 **VERTICAL WALL FORM SONOMETER.** Recommended in that it takes little space and that the tension is applied direct. With two wires, bridge clamps, etc., as illustrated, but without hangers and weights..... **27.50**

53–127 **SONOMETER STRINGS,** 0.014 and 0.028-inch diameter as used on above sonometer.....Pair **.35**



No. 53–135

No.53–125

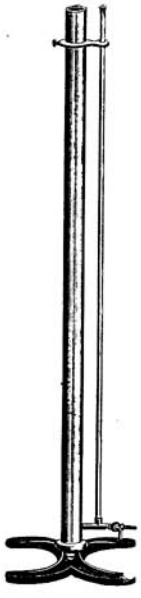
53–135 **LEVER TENSION SONOMETER.** Tension adjusted by weights sliding on levers, fine adjustment by tension keys. Without weights..... **12.00**

53–140 **SIMPLE SONOMETER** (see Millikan, Gale & Bishop, Exp. 41). Consists of **No. 27–392** Inclined Plane, **No. 27–393** Ball-Bearing Pulley in Frame and **No. 27–394** Sonometer Attachment..... **5.35**

27–394 **SONOMETER ATTACHMENT** as used in above..... **.60**

RESONANCE TUBES

No. 53–200



No. 53–205

No. 53–215

53–200 KNOTT'S 150-CM. RESONANCE APPARATUS for determining the wave length of a tuning fork, also for determining the velocity of sound in air. The tube is ample in size so that with a fork of pitch C′=256 V.P.S. a resonating column of ¾ of a wave length is possible. Without tuning fork, but otherwise complete as illustrated, with water reservoir and all necessary clamps and attachments for adjusting and supporting the various parts on the stand..... **$18.75**

53–205 FIVE-FOOT METAL RESONANCE TUBE WITH GLASS WATER LEVEL INDICATOR for determining the wave length of a tuning fork, also for determining the velocity of sound in air. Tube of ample size to give a resonating column of ¾ of a wave length for a tuning fork of pitch C′=256 V.P.S. This design combines advantages of other types and added advantages of facility of measurements and ease in varying height of water level. Complete as illustrated..... **13.50**

53–215 150-CM. RESONANCE APPARATUS WITH EAR TUBES (see Ames & Bliss's "Manual of Experiments in Physics," Exp. 40) for determining the wave length of a tuning fork, also for determining the velocity of sound in air. Without tuning fork, but otherwise complete as illustrated, with water reservoir and all necessary clamps and attachments for adjusting and holding the various parts on the stand..... **20.00**

No. 53–230

53–230 HORIZONTAL RESONANCE TUBE for measuring the velocity of sound in air. Glass tube with sliding piston mounted as illustrated..... **4.50**

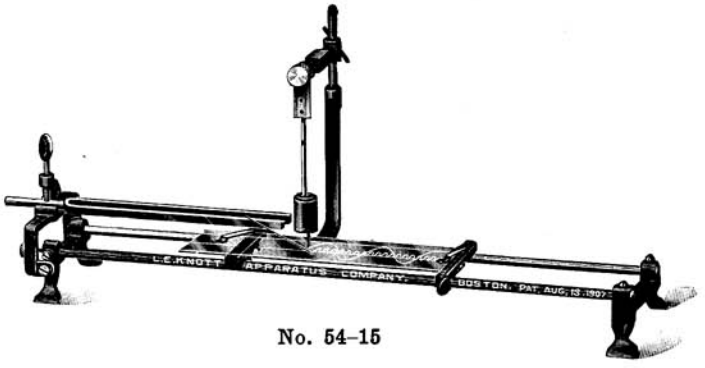
53–235 GLASS RESONANCE TUBES, fire polished ends, for use in resonance experiments.

	a	b	c
Length, cms.....	55	110	110
Diameter, cms.....	3.5	3.5	4
Each.....	**$1.10**	**$2.00**	**$2.85**

31–250 RESONANCE GLASS JARS for use in resonance experiments. Clear, colorless glass, with foot and rim.

	a	b	c	d	e
Size, inches	12×1½	12×2	15×2	15×3	18×3
Each.....	**$1.15**	**$1.25**	**$1.75**	**$2.00**	**$3.00**

STUDY OF SOUND VIBRATIONS



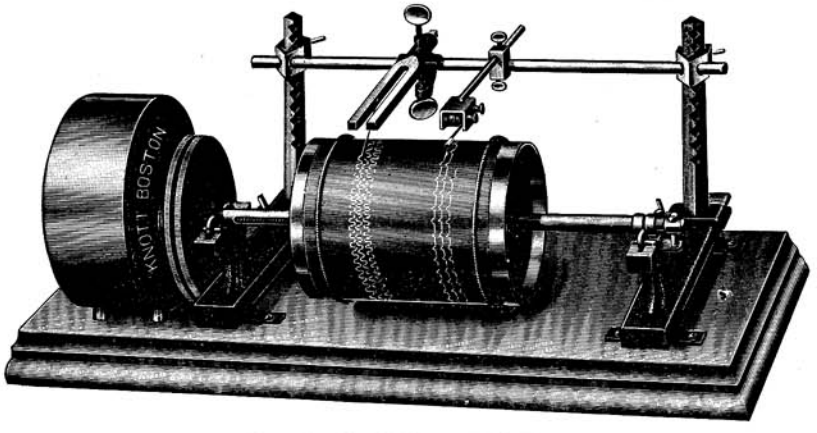
No. 54–15

54–15 KNOTT'S ALL-METAL UNIVERSALLY ADJUSTABLE VIBROGRAPH for determining the vibration frequency of a tuning fork. All parts except tracing plate are of metal, black oxidized or japanned. In addition to the durability of this design, our claims of accuracy with a minimum of trouble are fully justified. Without fork, but otherwise complete as illustrated **$7.75**

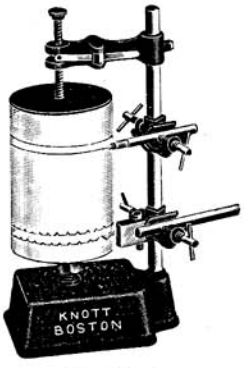
54–16 VIBROGRAPH TUNING FORK with metal stylus. Low pitch, large amplitude **1.85**

54–17 EXTRA GLASS PLATES for tracings. ..... Each **.15**

54–25 BRISTLE STYLUS AND FIXATIVE for use on a tuning fork when it is desired to record the vibrations on a smoked or coated plate or drum ..... **.30**



Nos. 54–30, 54–35 and 51–75



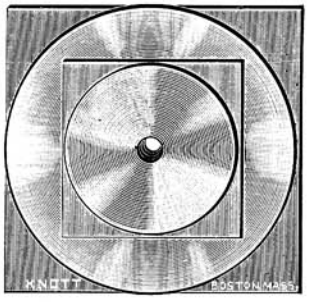
No. 54–40

54–30 VARIABLE SPEED CLOCK-DRIVE KYMOGRAPH, Invisible Non-Projecting Thread Feed. The recording drum, 12½ cms. diameter by 16½ cms. long, has a lateral movement of 16 cms. on a screw with thread so cut and mounted that the shaft does not extend beyond the bearings more than is shown in the illustration. Clock movement, mounted in a metal casting, is a standard 8-day movement, so connected that the recording drum, by a change in meshing gears, makes one revolution in 24 hours or one in 12 hours. The driving shaft rides on frictionless wheel roller. The time marker and tuning fork are adjustable along the rod. The rod, held at each end by a special clamp, is adjustable vertically; the uprights carrying the clamps are adjustable forward and backward. We claim a range of adjustment and a rigidity in various positions not found in any other instrument of this class. Ample room is provided for the simultaneous use of four tuning forks or six time markers. One may, therefore, make records of six different operations, no matter where located. Without tuning fork and time marker, but otherwise complete with clamp for tuning fork and holder for time marker. Arranged for clock drive **100.00**

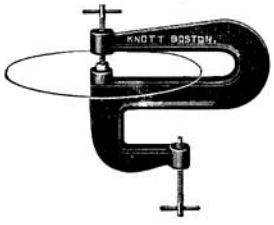
54–35 KYMOGRAPH TIME MARKER **7.75**

54–37 KYMOGRAPH RECORD SHEETS for use with above kymograph. Divisions to 5 and 10-minute intervals ..... Per fifty **3.50**

54–40 CLOCK RECORDING KYMOGRAPH. This instrument was designed and built at the request of Dr. W. T. Bovie of Harvard University, to provide a simple, easily-manipulated, effective device for recording the curve of plant growth with the Bovie Auxanometer (No. 3563). The clock mechanism mounted in the base, is a standard 24-hour clock movement of heavy construction. The recording drum is mounted in such a way that the weight of the drum assists, rather than retards, the clock movement. The recording drum is raised to the upper position by releasing a compression clamp and lifting the cylinder bodily. The range of movement and the length of the recording drum permit three or four records to be made at one time. With pencil holder, time marker and holder, complete as illustrated **27.50**

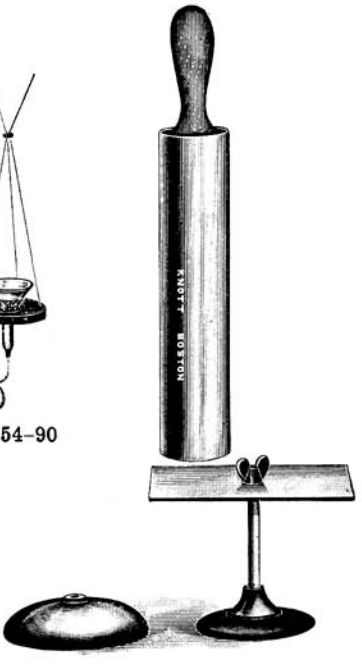


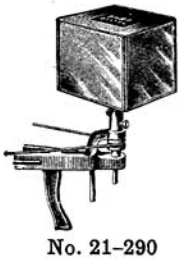
Nos. 54–126 to 54–134



No. 54–142

No. 54–90





No. 21–290

No. 21–295

No. 21–300

No. 55–10

54–90 **Y (SAND) PENDULUM** for the study of vibratory motions in two planes in illustrating Lissajous' figures. Modifications of the conditions upon which the relative phases and amplitudes depend are secured by varying the length of the stem of the Y by sliding the small brass ring up or down. The bob is of cast metal, designed to hold the small funnel which in use should be filled with fine sand which, when allowed to trickle forth, traces the path of the vibrating pendulum. Without sand and without support **$1.65**

CHLADNI'S FIGURES APPARATUS

Vibrating plates contain nodal lines which vary in number and position according to the form and size of the plate and the point at which they are set in vibration. We list below plates, clamps, and accessories for the proper conduct of the demonstration.

54–126 **ROUND CHLADNI'S PLATE,** 6 inches diameter **$2.25**
54–128 **——,** 10 inches diameter **2.75**
54–133 **SQUARE CHLADNI'S PLATE,** 6 inches square **2.00**
54–134 **——,** 10 inches square **2.50**
54–141 **CHLADNI'S PLATE CLAMP, small,** common type **1.25**
54–142 **——, large,** for plates up to 10 inches **3.50**
54–145 **LYCOPODIUM POWDER,** in cartons containing 4 ounces **1.50**
54–147 **SAND,** fine grained, carefully sifted, in cartons containing 8 ounces ..... **.20**
57–20 **DOUBLE BASS BOW,** recommended for exciting Chladni's plates **5.25**

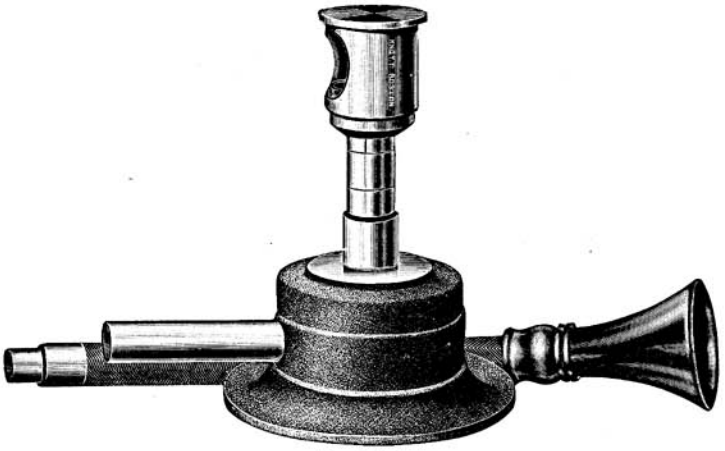
MANOMETRIC FLAME APPARATUS

54–165 **MANOMETRIC FLAME APPARATUS** for analysis of sound. Consists of Cubical Mirror **No. 21–290** and Manometric Flame Capsule **No. 21–295** (see page 41) **$12.25**
21–290 **CUBICAL MIRROR** as used in **No. 54–165** **6.25**
21–295 **MANOMETRIC FLAME CAPSULE** as used in **No. 54–165** **6.00**
21–300 **NON-VIBRATING REVOLVING MIRROR WITH POSITIVE SPEED CONTROL** (see page 41). Recommended for use with **No. 21–295** Manometric Flame Capsule in the study of manometric flames **25.00**
54–180 **MANOMETRIC FLAME APPARATUS** for analysis of sound. Consists of a manometric flame capsule, a simple construction with rubber tube and mouthpiece, and a mirror designed to revolve by hand **8.75**
55–10 **BELL, PLATE AND RESONATOR** for study of resonators. Consists of a brass tube with close-fitting sliding piston of sufficient length to respond to all notes above 256 V.P.S., a bell, 15 cms. in diameter, and a Chladni's Plate and simple stand to hold the bell or plate. Complete as illustrated **10.00**

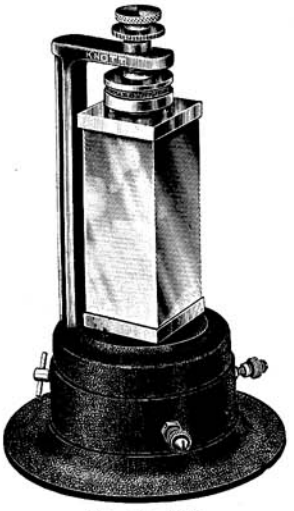
GRAPHIC ANALYSIS OF SOUND WAVES

No. 54-200

"SONOGRAPH"



No. 54-200



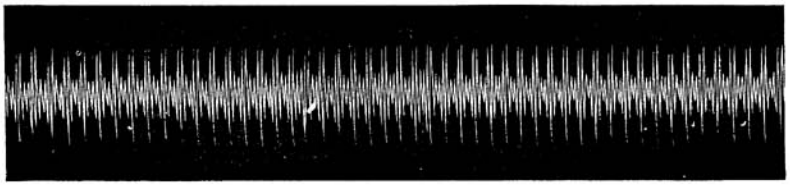
No. 21-300

54-200 "SONOGRAPH." The instrument above illustrated will show in a superior manner all manometric flame and, in addition, many other interesting experiments. Results are easily obtained, and both simple and complex tones are readily analyzed into their various wave forms, a pure tone depicting in a striking manner the fundamental sine wave.

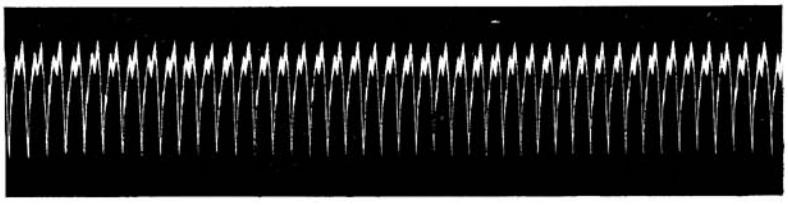
The operation of the "sonograph" depends on the compression and rarefactions set up in the air by sound — a spoken word, a note from an organ pipe, a tuning fork, etc. These compressions and rarefactions are communicated to a diaphragm which is set in vibration, the vibrations being greatly magnified by a small mirror, the amount of movement being indicated by the tracings of a spot of light on the screen. These tracings will take the form of waves if the spot of light be first directed on a rotating mirror. This rotating mirror should be placed between a lens and the screen. Our **No. 21-300,** illustrated above, described in Section 21, has been especially designed for this work. The speed is ingeniously governed for either very high pitch or very low pitch without stopping the motor which rotates the mirror.

To secure the most satisfactory results a strong source of light will be necessary. Sunlight is, of course, the best and when used, a "pencil" of light secured through a small aperture will be found most effective. When a projection lantern or any strong artificial source is used, a system of lenses should be provided to render the rays parallel. With a good arc light or light from the sun, the waves may be easily shown to five hundred students.

The waves illustrated below are photographic reproductions taken on a revolving film.



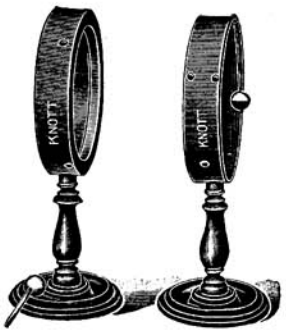
Wave Form of Tone - 435 V.P.S



Wave Form of Vowel e

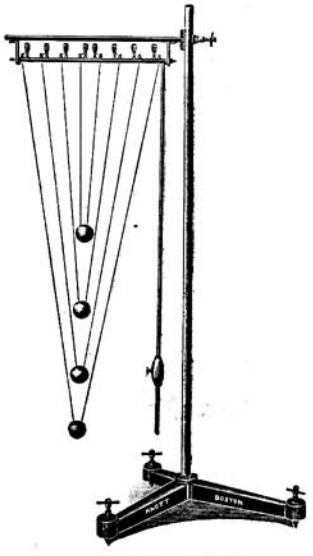
"SONOGRAPH" only, without lens, mirror, etc. **$35.00**

21-300 ELECTRICALLY OPERATED ROTATING MIRROR, designed especially for use with "Sonograph." For description see Section 21 ..... **25.00**



No. 55–70

No. 55–80



No. 55–77

No. 57–20

No. 56–20

No. 56–30

55–70 **VIBRATION APPARATUS** for study of sound waves. A disc is fastened over the face of each of the circular forms; a light ball is held suspended against one of the discs. This ball is set in motion if the face of the other disc is set in vibration by the small hammer. Complete as illustrated **$15.00**

55–77 **MORSE SYMPATHETIC VIBRATION APPARATUS** for study of sympathetic vibrations in simple pendulums and for determining under what conditions two bodies will vibrate in sympathy. Consists of a compound pendulum with adjustable disc bob, and four simple pendulums in bi-filar suspension, suspended from a common swivel support. If the compound pendulum is set vibrating, the simple pendulum, having the same vibration frequency, will begin to vibrate. Can be attached to any 19 mm. support rod. Without tripod stand and support rod..... **14.50**

55–80 **TREVELYAN'S ROCKER** for illustrating that musical vibrations are maintained by heat. When the bar is heated and placed with the sharp edges resting on the lead casting as illustrated, the bar begins to rock, emitting a harsh note which may be made higher in pitch by slightly pressing down on the bar..... **5.50**

21–280 **CROVA'S DISC AND SHIELD** (see page 41) for illustrating compressions and rarefactions set up in air particles by a sound wave..... **3.25**

56–20 **KUNDT'S APPARATUS** for demonstrating vibrations in a tube closed at both ends; also for measuring the velocity of sound in air. The tube is 110 cms. long, closed at one end by a movable tight piston, and at the other end by a loose-fitting piston at the end of a brass rod which, in use, is held rigidly by a special vise clamp. We have greatly improved the support, method of holding tube, and clamping the brass rod..... **10.00**

56–30 **KUNDT'S APPARATUS** for measuring the velocity of sound in various gases. The tube has air-tight metal caps, arranged so that piston rods can be readily adjusted. Fittings for introduction of various gases are attached to these metal caps. Complete as illustrated..... **27.50**

57–10 **PIANO WIRE,** best quality, in coils weighing 4 ounces.

	a	b	c	d
Diameter, inch.....	.028	.022	.0178	.014
Per coil.....	**$0.65**	**$0.75**	**$0.95**	**$1.15**

57–12 **PIANO WIRE, on spools.**

	a	b	c	d
Music Gauge No.....	12	9	7	5
Approximate diameter, inch...	.028	.022	.0178	.014
Approximate feet on spool....	6	8	8	10
Per spool.....	**$0.10**	**$0.12**	**$0.13**	**$0.15**

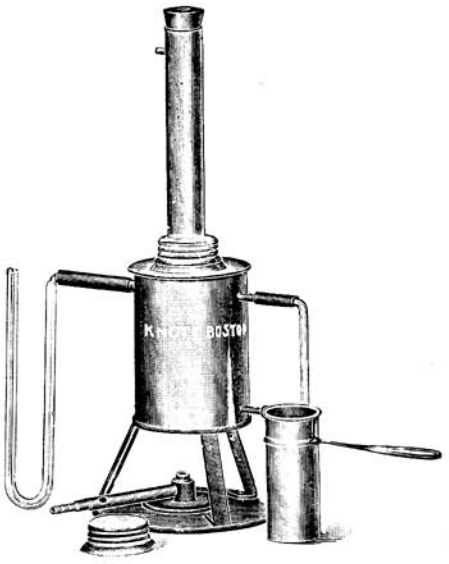
57–20 **DOUBLE BASS BOW**..... **5.25**

57–25 **RESIN,** best quality, moulded in form of cake.....Per cake **.10**

Wave Motion Apparatus. See Section 26.

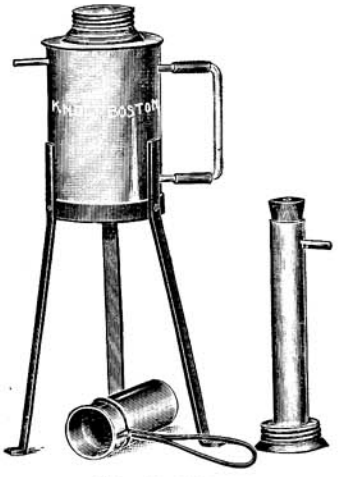
HEAT

GENERAL APPLIANCES FOR HEAT EXPERIMENTS



No. 60–350

No. 60–400



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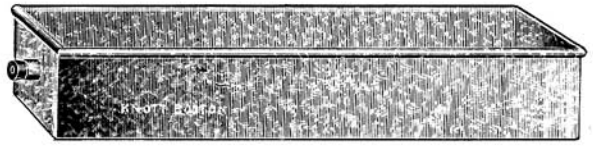

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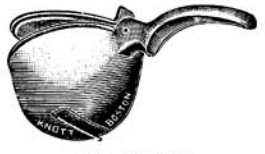


No. 60–440

60–350 **GILLEY COPPER STEAM BOILER (HYPSOMETER) Low Form,** designed originally for determining the boiling point of a thermometer, but for general use in experiments in which steam is required. Without rubber stopper, pressure gauge and burner, but otherwise complete as illustrated **$5.00**

60–30 **GILLEY LOW FORM BUNSEN BURNER** as illustrated with **No. 60–350** above ..... **.65**

60–100 **POLISHED BRASS ALCOHOL BURNER,** capacity 2 oz., recommended for use with **No. 60–350** when laboratory is not equipped with gas ..... **.85**

(For complete line of burners see pages 213 to 215)

60–365 **TURNER COPPER STEAM BOILER (HYPSOMETER) High Form** for ordinary Bunsen burner or (without tripod) for a stove similar to **No. 60–75** and **60–120.** Without rubber stopper, but otherwise complete as illustrated **5.40**

60–20 **SCHOOL BUNSEN BURNER** suggested for use with **No. 60–365** above ..... **.45**

60–390 **IMPROVED FORM PRESSURE GAUGE** for use with **Nos. 60–350** and **60–365** (see illustration **No. 60–350**) ..... **.35**

3640b **POLISHED SPUN COPPER BEAKER, 500 cc. capacity.** Useful in many experiments requiring a durable boiler or container **1.75**

3638b **POLISHED ALUMINUM BEAKER, 500 cc. capacity.** Useful in many experiments requiring a durable boiler or container **1.55**

60–400 **IMPROVED WATER TRAP.** The upper end of the outlet tube is curved, which prevents errors due to condensed steam passing into the calorimeter in experiments on determination of latent heat of steam ..... **.45**

60–405 **H-K STEAM TRAP.** A bottle with glass tubes and stopper, arranged to catch any condensed steam as it passes through the bottle ..... **.50**

60–430 **GALVANIZED IRON ICE TRAY with tubulature.** Designed to hold Charles Law Tube **1.35**

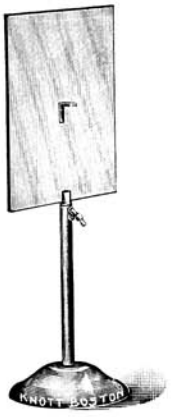
60–435 **CANVAS ICE BAG** for use as container in crushing ice for calorimetric experiments ..... **.45**

60–440 **ICE SHREDDER AND SHAVE.** Will make coarse or fine shavings **1.45**

RADIATION, REFLECTION, CONDUCTION, CONVECTION

No. 61–10

No. 61–11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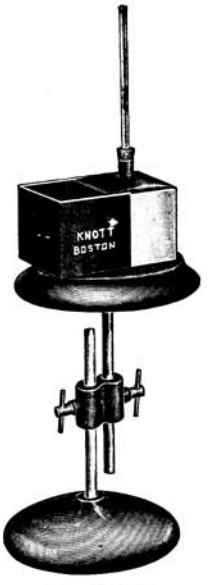

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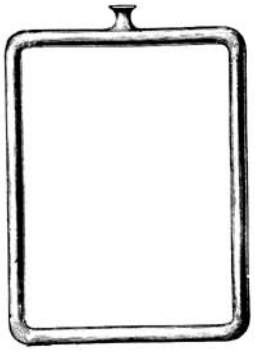
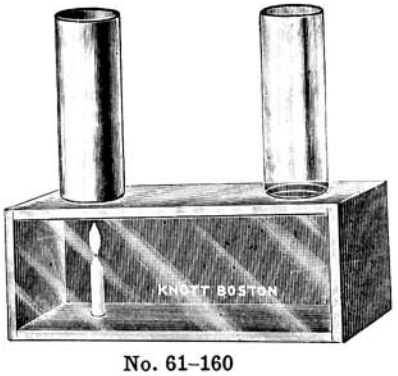
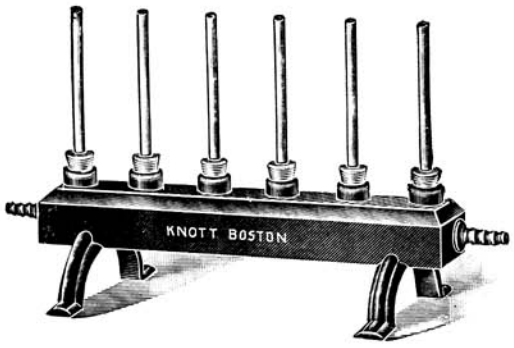

No. 61–150



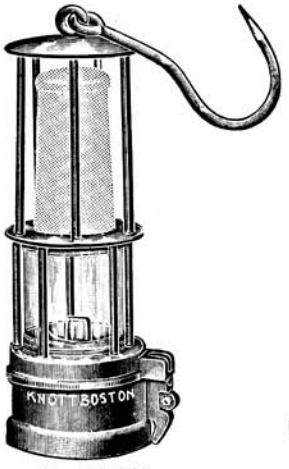
No. 61–160

No. 61–135

61–10	**CROOKE'S SINGLE BULB RADIOMETER** for illustrating attraction and repulsion from heat radiations. Excellent quality	$3.30
61–11	**CROOKE'S TWO-BULB RADIOMETER,** similar to above, but two bulbs with radiating vanes pivoted independently. Faces of vanes in one bulb blackened on opposite sides from faces in the other	6.25
52–10	**THIRTEEN-INCH UNIVERSALLY ADJUSTABLE TRUE PARABOLIC REFLECTORS** for showing reflection of heat waves (see page 90)	34.00
61–75	**RADIATION SCREENS** for comparison of absorptive power of two different substances. A pair of metal screens mounted as illustrated. One screen polished, one with face blackened; each with a small ledge at the back to hold a piece of phosphorus. Pair	5.50
61–100	**LESLIE'S CUBE** for comparison of the emissive powers of different substances. Consists of a 2½-inch, water-tight cubical metal tank with tubulature for introduction of hot water. One face of this cube is polished; the three other vertical faces are coated with substances having different emissive powers. Without stand and thermometer, but otherwise complete with three-sided protective case, as illustrated	3.85
61–105	**LESLIE'S CUBE** for comparison of the emissive powers of different substances. Consists of a 2½-inch water-tight cubical metal tank with four polished faces of different metals	4.00
	THERMOPILES for use with **Nos. 61–100** and **61–105.** See Section 64.	
	DIFFERENTIAL THERMOMETERS for use with **Nos. 61–100** and **61–105.** See Section 64.	
61–135	**COOLING CUP.** (See National Physics Direction Sheets, Exp. H100.) Two metal cups, one nickel-plated, the other blackened; each provided with wooden cover and insulating support ring	1.90
61–150	**CONVECTIONAL CURRENT APPARATUS** for illustrating convectional currents in liquids	1.65
61–160	**CONVECTIONAL CURRENT APPARATUS** for illustrating convectional currents in air. A metal box with glass window and glass chimneys	3.50
61–161	**CHIMNEYS, straight form.** Each	.35
70–50b	**CANDLES, twelves** (12 to the pound). Per dozen	.40
61–163	**TOUCH PAPER.** Sheet	.10

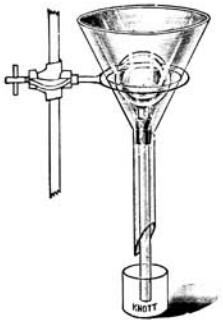


No. 61-175



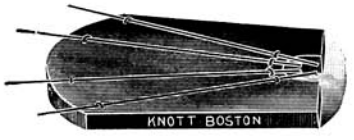
No. 61-215

No. 61-178



No. 61-195

No. 61-185



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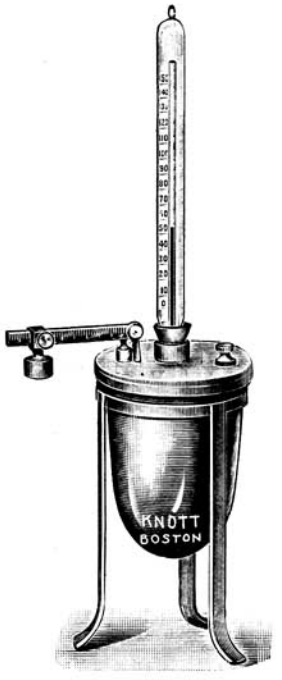


No. 62-10

61-175 **HARCOURT COMBINATION VERTICAL CONDUCTOMETER** for demonstrating relative conductivities of different metals. A cast metal steam chamber with steam inlet and outlet tubes, and six tubulatures into which are fitted stoppers holding the different metal rods, each with a concave end for holding a piece of phosphorus **$6.80**

61-178 **HEXAGONAL COMBINATION CONDUCTOMETER** for demonstrating relative conductivities of different metals. A hexagonal casting into each face of which is threaded a metal rod, the brass rod terminating in a handle. At an equal distance from the faces of the hexagonal casting, is a concavity for holding a piece of phosphorus **3.00**

61-180 **PRIMARY CONDUCTOMETER** for demonstrating relative conductivity of metals. Four metal rods fastened to a wood backing, as illustrated **1.00**

61-185 **COMPOUND ROD** for a comparative conductivity illustration. A rod, 5 inches long, part brass and part wood ..... **.70**

61-195 **CONDUCTIVITY OF WATER APPARATUS** (see Millikan & Gale, Fig. 198). Without stand and dish **1.25**

61-215 **DAVY'S SAFETY LAMP** for demonstrating the high conductivity of a metal gauze, applied in principle to the manufacture of miners' lamps **5.75**

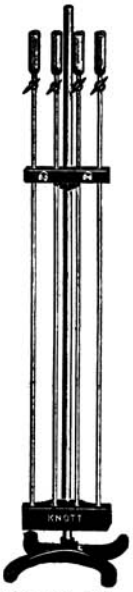
61-220 **LIQUID CONDUCTION TUBE** for demonstrating the slight conductivity of water. Water may be boiled in the upper part of the glass tube while ice remains unmelted at the lower end ..... **.25**

62-10 **PAPIN DIGESTER** for demonstrating the rise in boiling point by increase in pressure. This is a strongly-constructed brass boiler about 5 inches high by 3½ inches average diameter. With gasket and heavy metal cap, which may be rigidly clamped to boiler. This cap is provided with a hole for thermometer and also with a safety valve. Complete as illustrated with safety valve and weight, tripod support, and thermometer **19.00**

62-11 ——, similar to above, but with addition of pressure gauge **23.00**

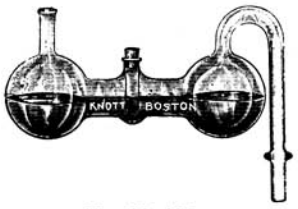
62-15 **BOILING POINT OF ALCOHOL TUBE** (see Millikan, Gale & Bishop, Exp. 23) ..... **.45**

62-16 **BEVELED GLASS TUBE,** 20 cms. long (see National Physics Direction Sheets, Exp. H012) ..... **.20**



No. 62–50

No. 62–150



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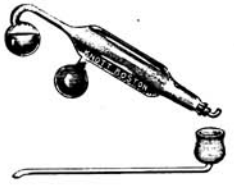
No. 62–140



No. 62–160

No. 62–200

No. 62–20

No. 43–310

No. 62–240

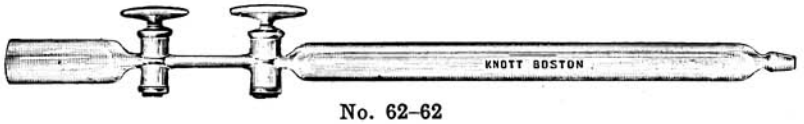
62–20 **VAPOR PRESSURE TUBE** for determining vapor pressure and boiling point of a liquid. The stopcock is practically indispensable for facility in excluding the air from closed arm, and for introduction of the liquid; also for proper cleaning of the tube..... **$2.25**

62–50 **VAPOR TENSION APPARATUS** for direct comparison and measurement of the vapor tensions of different liquids. Tubes are uniform in bore and heavy walled. The clamp is of metal throughout, and gives effective support to each tube. The mercury trough at the lower end is of cast iron, so designed that the minimum amount of mercury is required. Complete as illustrated..... **24.50**

62–51 **VAPOR TENSION TUBES** as used in above.....Each **3.30**

62–53 **VAPOR TENSION APPARATUS** similar to **No. 62–50,** but tubes not provided with stopcocks.. **14.10**

62–54 **VAPOR TENSION TUBES,** as used in above.....Each **.70**



No. 62–62

62–62 **VAPOR TENSION TUBE WITH CAPILLARY OF KNOWN VOLUME.** This tube may be adjustably mounted in place of the air thermometer bulb as illustrated over **No. 64–55,** (Page 104). The capillary between stopcocks is of known volume..... **3.90**

62–90 **WOODEN HEAT SHIELD** for use as a shield against heat rays. A board mounted upright and provided with a hole for the passage of a steam delivery tube..... **1.10**

LIEBIG CONDENSERS. See page 225.

62–140 **FRANKLIN'S PALM or PULSE GLASS** for illustrating influence of pressure on boiling. Two connecting glass bulbs, filled with water and water vapor..... **1.40**

62–150 **WOLLASTON CRYOPHORUS** for illustrating freezing by evaporation. Rapid evaporation of water in upper bulb, caused by condensation of water vapor in bulb in freezing mixture, causes the water to freeze in upper bulb..... **2.75**

62–155 **CARRE'S FREEZING APPARATUS** for demonstrating freezing of water by its own evaporation at the same time causing ether to boil. Apparatus is filled one-third full with C. P. Sulphuric Acid, small vial, one-half full with ether and loosely stoppered. The projecting tube is connected air-tight to a flask containing water to be frozen. The other tube is connected by means of a stopper and tubing to an air pump. Air exhausted from apparatus causes rapid evaporation of water which freezes in flask. The water vapor is absorbed by the sulphuric acid which soon becomes hot, causing ether to boil and blow out the stopper..... **3.85**

62–160 **SULPHURIC ACID CRYOPHORUS,** for a spectacular experiment, illustrating freezing of water by its own evaporation. Complete as illustrated with full directions for use..... **4.00**

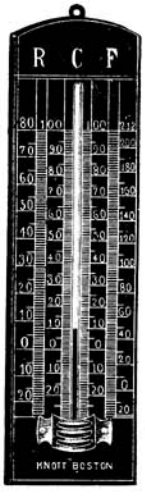
43–310 **FREEZING APPARATUS** for demonstrating the freezing of water by the rapid evaporation of ether. As air is exhausted from bell glass, ether evaporates rapidly, freezing the water in the watch crystal. Complete as illustrated..... **2.75**

62–200 **DEW POINT APPARATUS** (see Millikan, Gale & Bishop, Exp. 10A). Complete as illustrated.... **1.85**

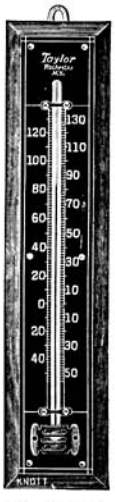
62–240 **CUBICAL EXPANSION BULB** for determining the point of maximum density of water. When filled with water, sufficient to fill the bulb and three quarters of the graduated neck, the bulb is immersed in water, the temperature of which is taken. Freezing mixture is added to bath and continuous readings of thermometer and graduated neck are taken. A point will soon be reached where the reading on the neck does not descend as the temperature decreases but at this point will begin to rise, showing that this is the point of maximum density. This point will be found at about 4° Centigrade..... **2.45**

No. 63–50

No. 63–10



No. 63–15



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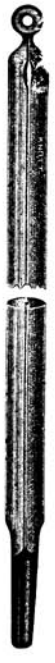

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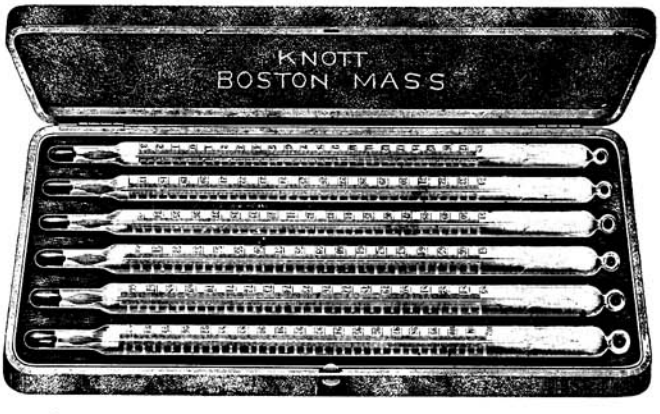


No. 63–126

No. 63–60

No. 63–18

No. 63–130

MEASUREMENT OF HEAT

63–10 **LABORATORY WALL THERMOMETER, Inside or Outside,** 8-inch, heavy metal case, metal scale, −30 to 120° F. **$1.50**

63–12 ——, 10-inch, metal scale on hardwood back, range −30 to 120° F. **1.75**

63–15 **COMPARATIVE THREE SCALE THERMOMETER, 10-inch,** Fahrenheit, Centigrade and Reaumur. Boxwood, piano finish, graduations and figures filled black **1.40**

63–18 **DEMONSTRATION METALLIC THERMOMETER, 6 inches diameter,** range −50 to 150° F. Glass back permits view of entire mechanism **6.25**

63–20 **GROUND GLASS UNGRADUATED THERMOMETER, 13 inches long,** one-half of circumference etched through its entire length so that student can determine and mark in pencil on the etched portion both the zero and boiling points, and make a complete thermometer.
Each, **$1.40** Per dozen **16.50**

63–50 **CENTIGRADE CHEMICAL THERMOMETER, −10 to 100° C.,** 12 inches long, stem scale, white enamel back **1.50**

63–51 ——, **−10 to 150° C** **2.00**

63–52 ——, **−10 to 200° C.,** 14 inches long **2.15**

63–53 ——, **−10 to 250° C.** **2.50**

63–55 ——, **−10 to 350° C.** **3.00**

63–56 **FAHRENHEIT CHEMICAL THERMOMETER, −15 to 220° F.,** 12 inches long, stem scale, white enamel back **1.50**

63–56A ——, **−15 to 300° F.** **2.00**

63–57 ——, **−15 to 600° F.,** 14 inches long **3.00**

63–60 **DOUBLE SCALE CHEMICAL THERMOMETER, 100° C. and 220° F.,** 14 inches long, stem scale, white enameled back **2.50**

63–62 ——, **200° C. and 400° F.** **3.00**

63–64 ——, **350° C. and 700° F.** **3.50**

63–80 **CENTIGRADE CHEMICAL THERMOMETER, 1/5° divisions, 0 to 100° C.,** 16 inches long, stem scale, white enameled back, high grade **4.50**

63–85 ——, **1/10° divisions, 0 to 100° C.,** 24 inches long **8.00**

63–110 **LABORATORY INCUBATOR THERMOMETER, 1° divisions, 0 to 50° C., with 37½° point marked in red.** Length about 10 inches, enclosed milk glass scale **4.25**

63–124 **STANDARD LABORATORY SET OF CERTIFIED CENTIGRADE THERMOMETERS** as made for the Supervisory and Control Laboratories of the War Department. Five thermometers, −0 to 60° C. in 1/10°, 50 to 100° C. in 1/10°, 100 to 150° C. in 1/10°, 150 to 200° C. in 1/10°, and 200 to 360° C. in ½° divisions. In plush-lined case **55.00**

63–126 **STANDARD CENTIGRADE THERMOMETERS after ANSHUTZ.** Enclosed milk glass scales, ½° divisions. Seven thermometers, −10 to 55° C., 55 to 110° C., 95 to 160° C., 150 to 210° C., 200 to 255° C., 250 to 310° C., and 300 to 360° C., in plush-lined leather case. (Illustration shows but six thermometers) **42.00**

63–130 **BECKMANN DIFFERENTIAL CENTIGRADE THERMOMETER,** range 5° by units of 1/100°, milk glass scale. Without auxiliary scale **25.00**

63–131 ——, **with auxiliary scale** **30.00**

63–150 **CALORIMETRIC THERMOMETER, especially adapted to the Emerson Calorimeter,** graduated from 17 to 32° C. in 1/50° divisions **20.00**

63–151 ——, **with Bureau of Standards Certificate** **40.00**

63–153 **CALORIMETRIC THERMOMETER, especially adapted to the Parr Calorimeter,** graduated from 65 to 90° F. in 1/20° divisions **15.00**

63–154 ——, **with Bureau of Standards Certificate** **25.00**

63–168 **LOW TEMPERATURE CENTIGRADE THERMOMETER, Toluol Filled.** Graduated from −95 to 30° C. in single degree divisions **13.50**

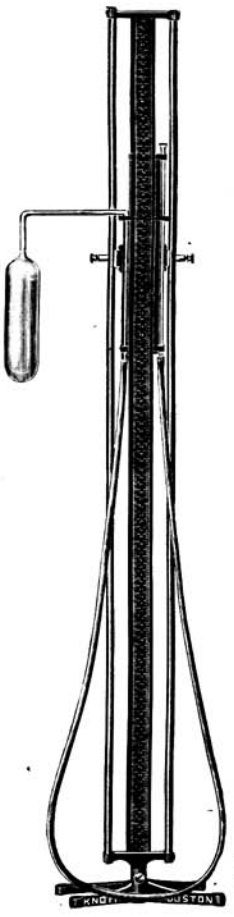
63–169 ——, **Pentane Filled,** graduated from −200 to 30° C. in single degree divisions **18.75**

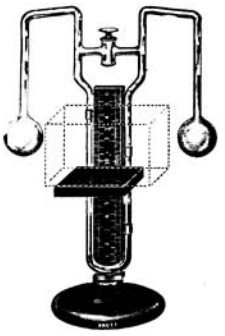
"TITER" THERMOMETERS, especially designed for making what is known as the "Titer" test in soap and fat-testing laboratories. Bulbs of normal glass, stems finest quality of glass, magnifying lens front.

Cat. No.	63–200	63–201	63–202	63–203	63–204	63–205	63–206	63–207
Range	0–20° C.	10–30° C.	15–25° C.	20–30° C.	20–40° C.	30–50° C.	40–60° C.	0–75° C.
Units	1/10°	1/10°	1/10°	1/10°	1/10°	1/10°	1/10°	1/5°
Price	**$7.50**	**$7.50**	**$7.50**	**$7.50**	**$7.50**	**$7.50**	**$7.50**	**$7.50**

63–225 **MENISCUS READER for Beckmann Thermometers, Burettes, etc.** Improved form with unobstructed vision **10.00**

63–226 ——, **for Engraved Stem Thermometers** **10.00**





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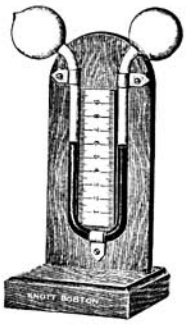

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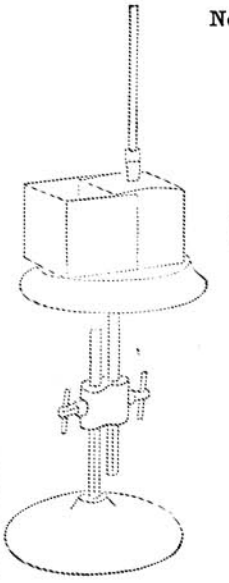

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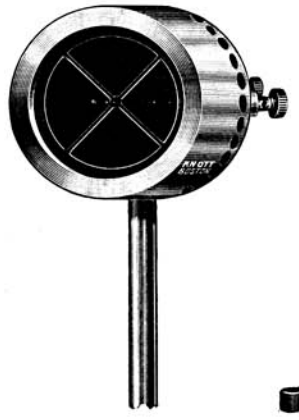


No. 64–100

No. 64–65

64–15 **UNIVERSAL AIR AND LIQUID DIFFERENTIAL THERMOSCOPE** for showing the temperature of two neighboring places or for indicating the temperatures of two liquids. The platform is designed to hold the source of radiant energy such as the Leslie's Cube. Bulbs are bent downward so that they can be immersed in liquids. The cross tube and stopcock are provided so that the liquid in each arm of the U-tube can be easily brought to the same level..... **$7.50**

64–20 **DIFFERENTIAL THERMOSCOPE** for indicating the difference of temperature between two neighboring places. Mounted complete as illustrated..... **3.75**

64–35 **AIR THERMOMETER, 2-inch bulb,** for illustrating gas expansion..... **.30**

64–55 **CONSTANT VOLUME AIR THERMOMETER** for determining the coefficient of expansion of air or of a gas. Stand, 150 cms. high; leveling tube and air thermometer each attached to a wooden strip provided with a clamp for clamping to rod in positions desired. Complete as illustrated.... **16.75**

64–57 **AIR THERMOMETER BULB,** glass part only as used in above..... **1.65**

64–65 **CONSTANT VOLUME AIR THERMOMETER** (see Millikan, Gale & Bishop, Exp. 14) for determining the coefficient of expansion of air. Complete as illustrated..... **4.50**

64–66 **——, without support**..... **2.50**

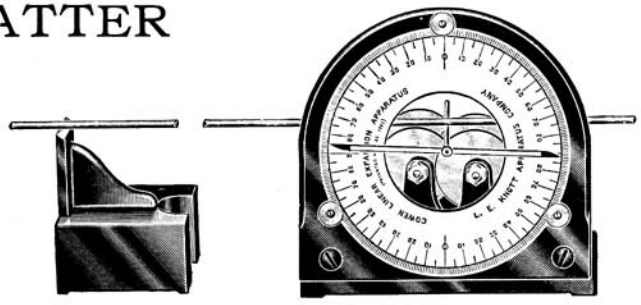
64–67 **AIR THERMOMETER BULB,** glass bulb only of above..... **.85**

64–100 **IMPROVED MINERALITE THERMOPILE "A"** for thermo-electric measurements. Consists of a polished brass casing in which is mounted the thermopile unit. This casing is attached to a rod which is held in a stand designed for universal adjustment. Actual tests show the 20-pair Bismuth Antimony Pile 300 per cent less sensitive when a unit area metallic surface at 100° C. is held 10 cms. from the face of the pile. With direct sunlight as source of heat, it is approximately 500 per cent. less sensitive. We claim increased sensibility, mechanical strength and durability **19.00**

64–110 **IMPROVED MINERALITE THERMOPILE "B,"** similar to above, but 500 per cent. more sensitive than the 20-pair Bismuth Antimony Pile under unit area metallic surface at 100° C., 10 cms. distance from face of the pile, and approximately 1000 per cent. more sensitive under direct sunlight as the source of heat..... **24.00**

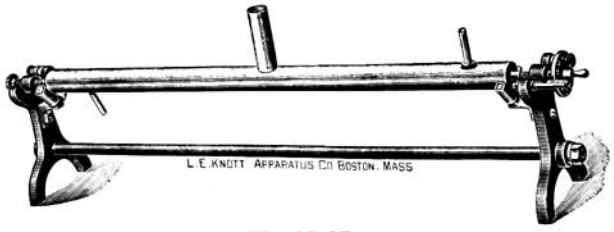
EXPANSION OF MATTER

65–10 COWEN'S LINEAR EXPANSION APPARATUS for the rapid measurement of linear expansion of solids. The solid is a tube, one end of which is free to move as it is expanded by heat from steam passed through the tube. This expansion is greatly multiplied by the multiplying device and can be accurately read from the graduated dial. Constructed of metal throughout. Complete as illustrated, with one brass tube..... **$5.50**



No. 65–10

65–11 STEEL TUBE for use with above..... **$0.95**
65–12 ALUMINUM TUBE for use with above..... **.75**
65–13 BRASS TUBE as used in above..... **.55**
65–14 GLASS TUBE for use with above..... **.40**

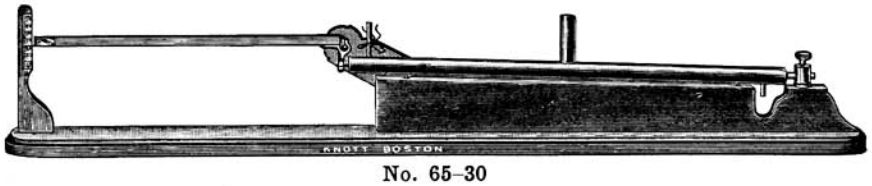


No. 65–27

65–16 GLASS RESERVOIR AND STIRRER. (See National Physics Direction Sheets, Exp. H023)..... **.50**

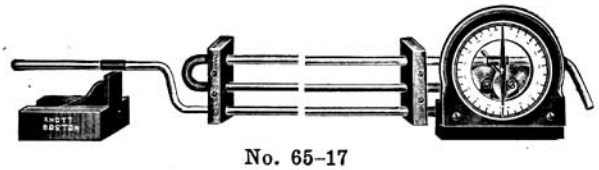
65–22 LEVER FORM LINEAR EXPANSION APPARATUS, metal construction throughout, for measuring the linear expansion of a solid (a rod). Expansion is caused by heat from steam introduced into the metal jacket. The expansion is determined by a multiplying lever, the long arm of which moves over a scale. Complete as illustrated, with one brass rod..... **7.75**

65–27 MICROMETER SCREW FORM LINEAR EXPANSION APPARATUS, metal construction throughout, for measuring the linear expansion of a solid (a rod). Expansion is caused by the heat from steam introduced into the metal jacket. The expansion is measured directly from the reading of the micrometer screw. Complete as illustrated, with one rod..... **9.50**



No. 65–30

65–30 IMPROVED LEVER FORM LINEAR EXPANSION APPARATUS for measuring the linear expansion of a solid (a rod). The steam jacket rests on an insulating support, obviating errors due to radiation. Expansion is determined by a multiplying lever, the long arm of which moves over a scale. Complete as illustrated, with one brass rod..... **9.35**
65–45 ALUMINUM ROD for use with **Nos. 65–22 to 65–30**..... **.55**
65–46 IRON ROD for use with **Nos. 65–22 to 65–30**..... **.45**
65–70 BRASS TUBE AND POINTER. (See Millikan, Gale & Bishop, Exp. 15)..... **1.65**



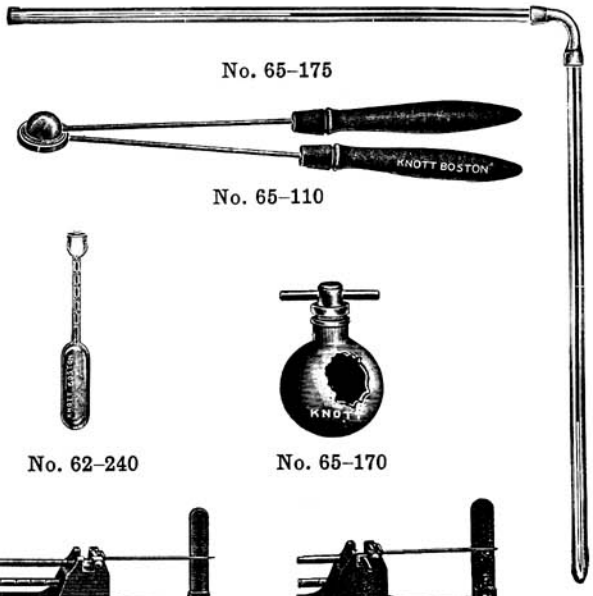
No. 65–17

65–17 COWEN'S COMPENSATION APPARATUS for demonstrating the effect of multiple bars of different coefficients of linear expansion as employed in compensation or compound pendulums. Consists of an Expansion Attachment **No. 65–18** and the metal rest and multiplying device of Expansion Apparatus **No. 65–10.** As steam enters from a steam boiler, the tube reached first by the steam expands, causing the pointer to make a movement to the left; when steam reaches the second tube which has the greatest coefficient of linear expansion, the pointer moves to the right, back to and well beyond the zero point; when steam reaches the third tube, the pointer moves back to the left, stopping at zero. Complete as illustrated..... **8.75**

65–18 COWEN'S COMPENSATING ATTACHMENT for use with No. 65–10 Linear Expansion Apparatus. The expansion bars (three tubes) are held together by two clamps on the same principle as the multiple bars are held in the compensated pendulum..... **3.80**

COMPENSATING PENDULUM. See **No. 17–60.**

No. 65–75



No. 65–175

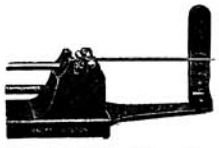
No. 65–80

No. 65–150

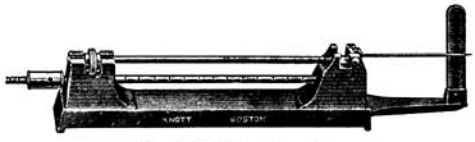
No. 65–110

No. 62–240

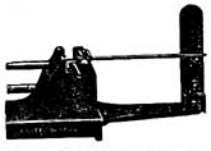
No. 65–170



No. 65–130 (Fig. 2)



No. 65–130 (Fig. 1)



No. 65–130 (Fig. 3)

No. 65–180

65–75 **COMPOUND BAR** for illustrating unequal expansion of metals. Two metals, brass and iron, are welded together and attached to an insulating handle as illustrated..... **$1.25**

65–80 **COMPOUND BAR WITH INDICATOR** for illustrating unequal expansion of metals. Two metals, brass and iron, are welded together and so mounted that any expansion is indicated by a multiplying lever moving over a graduated arc..... **6.75**

65–110 **GRAVESEND BALL AND RING** for illustrating expansion of metal upon application, and contraction upon withdrawal of heat. The polished metal ball is accurately fitted to just pass through the cast metal ring at room temperature. When heated, it cannot be drawn through the ring; when cooled, it fits the ring loosely. Complete as illustrated..... **1.90**

65–130 **PACKARD'S BREAKING BY EXPANSION AND CONTRACTION APPARATUS** for illustrating power exerted by an expanding or contracting metal bar.

Fig. 1 shows apparatus set up as a simple linear expansion apparatus; Fig. 2 shows arrangement for breaking the small steel rod by contraction; Fig. 3 shows arrangement of steel rod for breaking by expansion.

Apparatus is furnished complete as illustrated, with twelve steel bars for breaking tests..... **17.25**

65–150 **HOPE'S MAXIMUM DENSITY OF WATER APPARATUS** for demonstrating the point of maximum density of water; illustrates why the surface of a pond may be covered with ice while water is underneath surface. If the jar is filled with water and a freezing mixture placed in the copper container fastened outside the jar, the lower thermometer will register a lower temperature until 4° C. is reached, at which point the reading will remain stationary; but the upper will continue to register lower until 0° C. is reached, and ice is formed on the surface. Without thermometers, but otherwise as illustrated..... **9.00**

62–240 **DESPRETZ WATER THERMOMETER** for showing cubical expansion of a liquid, also for determining the maximum density of water. Stem graduated to millimeters..... **2.45**

65–170 **FREEZING BOMB** for demonstrating the tremendous expansive force exerted as water freezes. The sphere is cored to contain about two ounces of water..... **1.40**

65–175 **CHARLES LAW TUBE** (see Hall & Bergen), for showing that under constant pressure, different gases possess the same coefficient of expansion. The tube with closed end contains dry air. The capillary tube with open end contains an indicating globule of mercury..... **1.90**

65–180 **WATERMAN'S CHARLES LAW TUBE** for similar use as above. The capillary tube has a closed end and contains dry air stoppered by a globule of mercury..... **2.15**

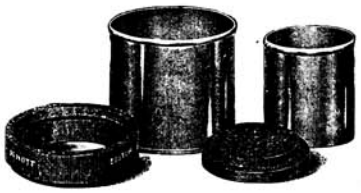
65–191 **VOLUME COEFFICIENT TUBE.** (See Millikan, Gale & Bishop, Exp. 14A)..... **.30**

MEASUREMENT OF QUANTITY OF HEAT

CALORIMETERS

No. 66–45

No. 66–65



No. 66–35

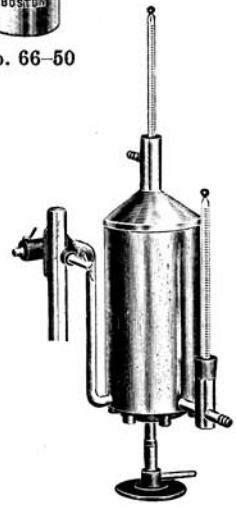
No. 66–50

No. 66–100

No. 66–105

No. 66–110

No. 66–75



No. 66–125

66–35 **CINCINNATI DOUBLE WALL CALORIMETER.** Consists of two nickel-plated brass vessels, the smaller resting on a supporting ring within the larger. A cover with holes for thermometer and stirrer is supplied with the outfit. Complete **$2.00**

66–45 **DOUBLE WALL CALORIMETER,** similar to above but larger, and spun from sheet copper. Heavily nickel-plated inside and out. A cover with holes for thermometer and stirrer is supplied with the outfit. Complete **5.25**

66–50 **CULLER'S CONDENSER ATTACHMENT** for use with above or other calorimeters to determine latent heat of steam. (See Culler's " Laboratory Manual of Physics," Exp. XXIII) **1.50**

66–65 **CALORIMETER** for general use in secondary school work. Capacity approximately one liter ..... **.90**

66–70 **STIRRER** for use with above calorimeter ..... **.40**

66–75 **BUNSEN'S ICE CALORIMETER, standard type** **1.75**

66–100 **IMPROVED ELECTRIC CALORIMETER** for applying Joule's Law in the determination of the constant of a galvanometer. The calorimeter proper is of form shown under **No. 66–105,** mounted as illustrated, the space between the outer chamber and the polished surface of the calorimeter being filled with a heat insulating compound consisting largely of magnesium carbonate. Complete **18.75**

66–105 **DOUBLE WALLED ELECTRIC CALORIMETER** (see Millikan & Mills' " Electricity, Sound and Light," Exp. 4), for testing the calibration of a voltmeter by an absolute determination of potential difference. The heating coil is a fine platinum wire wound on an insulating strip. The ends of this coil are connected to two brass rods which extend through the cover and terminate in binding posts. The calorimeters are of spun copper, the inner of about 350 cc. capacity, insulated from and supported on the outer by a fibre ring. Complete with stirrer **13.00**

66–108 **HEATING COIL ATTACHMENT.** Consists of the heating coil unit with cover of **No. 66–105.** Teachers who already have **No. 66–45** Calorimeter need order this attachment only **7.75**

66–110 **STUDENTS' ELECTRIC CALORIMETER** for determining the number of heat calories developed in a wire; also for the study of Joule's Law. The ends of the heating coil are electrically attached to brass rods which pass through the cover and terminate in binding posts. Without thermometer, **3.50**

66–125 **SIMPLIFIED JUNKER'S CALORIMETER** for determining the calorific power of combustible gases. In the design above illustrated the heated gases enter the inner chamber of a triple-walled vessel. Within this chamber these gases come in contact with a coil of copper tubing through which a current of water flows continually. The temperature of this water is noted at entering as well as upon issuing from the coil, by means of the thermometers noted in the illustration. In order to determine the B. T. U., the quantity of gas consumed and the quantity of water passed through the apparatus must be determined in addition to the difference in temperature. In determining the quantity of gas consumed we advise our **No. 66–130** Thorpe Gauge. Without stand, thermometers and Bunsen burner, but otherwise complete as illustrated **22.00**

66–130 **THORPE GAUGE** for measuring pressure of gas or rate of gas flow. To read pressure of gas screw cap down over outlet at the top and connect gas supply to the inlet. Index on left scale gives reading of pressure in inches of water. With cap removed from outlet and gas allowed to flow through the gauge, the indicator registers on right hand scale the rate of flow of the gas in cubic feet per hour **17.50**

EMERSON CALORIMETERS. See pages 216-219.

SPECIFIC HEAT DETERMINATIONS

66–170 **LEAD CYLINDER WITH CONICAL TOP,** weight approximately 650 grams (see Fuller & Brownlee, Exp. 58) **$0.95**

66–175 **LEAD SHOT.** ..... Per lb. **.25**

66–177 **COPPER SHOT.** ..... Per lb. **.70**

66–179 **ALUMINUM SHOT.** ..... Per lb. **.95**

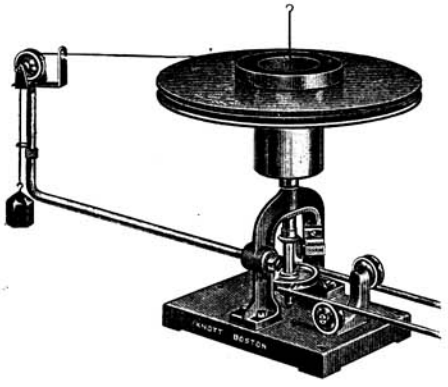
3615 **GLASS BEADS.** ..... Per lb. **1.90**

66–200 **TYNDALL'S SPECIFIC HEAT APPARATUS** for qualitative determination of the comparative specific heats of different metals. Consists of a paraffine disc with tin plate for casting new discs, five balls of different metals, handle for holding balls while heating them, and a tripod support **3.20**

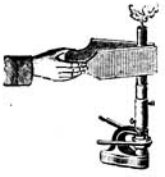
No. 66–200

MECHANICAL EQUIVALENT OF HEAT

No. 67–25



No. 67–20



No. 21–120

No. 67–50

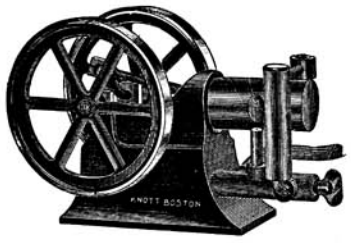
67–20 **MECHANICAL EQUIVALENT OF HEAT APPARATUS** for determining the mechanical equivalent of heat. The design of the instrument was worked out at the Cavendish Laboratory in Cambridge. In operation it utilizes the principle of heating a given quantity of water by friction, both the water and the friction surfaces being placed in a carefully insulated calorimeter, all sources of error either being eliminated or accurately accounted for. The friction unit consists of hollow truncated cones turned and hand finished to assure absolute uniform contact. One of these cones is attached to the driving shaft, the other to the top wooden disc. Not only are these cones carefully insulated from the casing to prevent radiations, but also an ample air jacket is provided to insure as nearly perfect insulation as practicable. The vertical drive shaft is most carefully centered so that the friction unit rotates in a definite plane. Complete as illustrated with ten feet round leather belting and patent belt fastener, and with detailed laboratory directions **$85.00**

67–25 **MECHANICAL EQUIVALENT OF HEAT TUBE, double insulated, metal capped** (see Millikan, Gale & Bishop, Exp. 20). This tube is a full meter in length, is of heavy corrugated board, covered inside and outside with heavy paper. Ends are closed by cork stoppers and close-fitting metal caps **1.10**

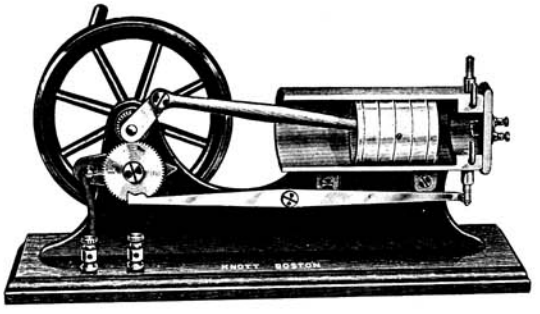
21–120 **TYNDALL'S HEAT BY FRICTION APPARATUS** for use with a rotator to illustrate generation of heat by expense of mechanical energy **4.85**

67–50 **FIRE SYRINGE** for illustrating the generation of heat by rapid compression of gases. On the end of the piston which fits tightly in the brass cylinder is a holder for a small piece of tinder. Rapid compression of the air in the cylinder generates heat sufficient to ignite the tinder. We suggest that the tinder be moistened with ether or carbon disulphate **5.00**

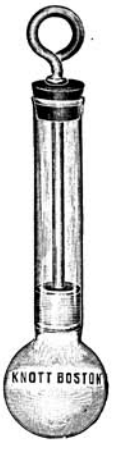
GAS ENGINES — STEAM ENGINES



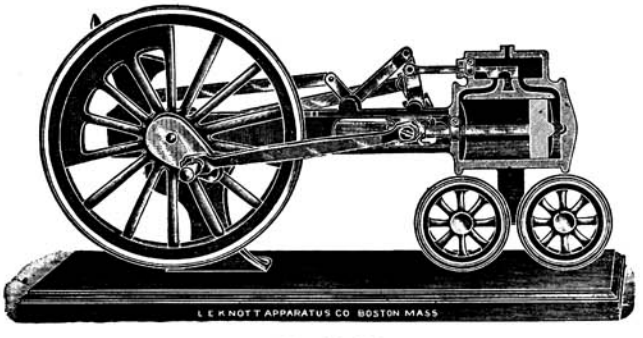
No. 68–40



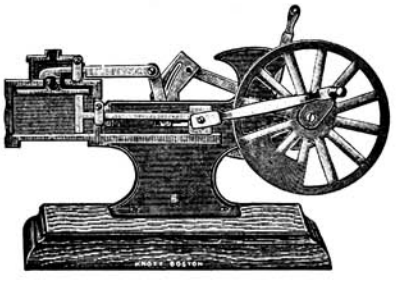
No. 68–50



No. 69–10



No. 69–35



No. 69–30

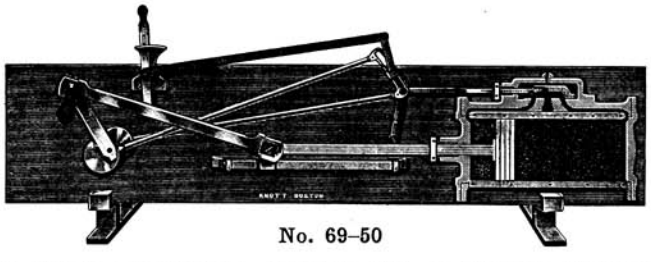
68–40 **GAS ENGINE** for demonstrating motive power by gas explosions. This is a working model gas engine about 6 inches long. Speed from 200 to 700 R.P.M. **$8.50**

68–50 **IMPROVED SECTIONAL MODEL GAS ENGINE WITH SPARK ADVANCING AND SPARK RETARDING DEVICE** for study of operation of a four-cycle commercial gas engine. This is a model complete with all essential parts and of sufficient size for classroom demonstration of the principles involved and the operation of the various parts of a commercial gas engine. It can be shown how compression and exhaustion are accomplished, and if the secondary of a Ruhmkorff's Coil be connected in series with the spark plug, the spark may be shown at the proper moment by compression. With our model we can advance or retard the spark **25.00**

69–10 **WOLLASTON STEAM ENGINE** for illustrating the expansive force of steam. As steam is generated in the bulb, the piston is forced up. If the steam is condensed by plunging bulb into cold water, the atmospheric pressure forces back the piston **1.50**

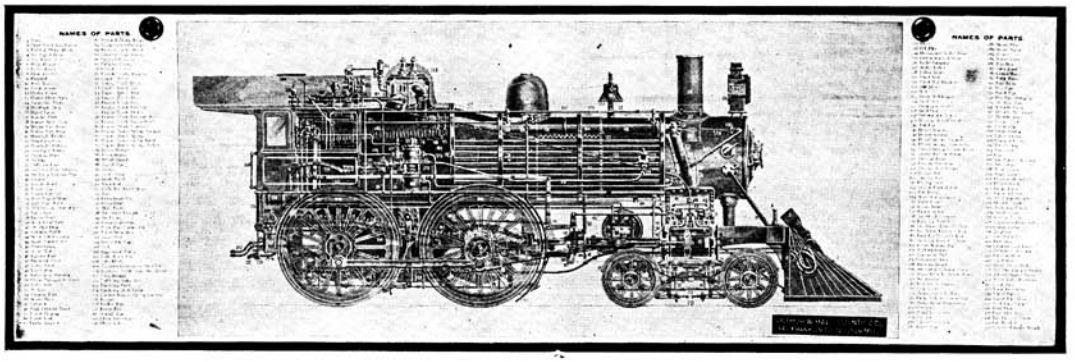
69–30 **SECTIONAL MODEL OF A STEAM ENGINE** for illustrating the application of principle of a steam engine to driving a locomotive. All parts are carefully fitted and adjusted to show clearly the movements of slide valve, piston, eccentric, reversing gear, link motion, etc **6.00**

69–35 **EIGHTEEN-INCH SECTIONAL MODEL OF A STEAM ENGINE** for lecture-table demonstration of operation of a locomotive. This model is considerably larger than **No. 69–30** and all the parts are, of course, correspondingly larger and consequently can be seen by a greater number. Essential parts are finished or colored to make the essential features stand out clear and sharp... **23.50**



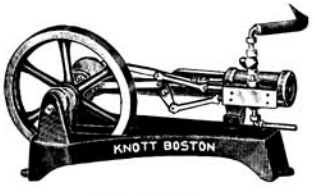
No. 69–50

69–50 **MILLER'S FOUR-FOOT SECTIONAL MODEL OF A STEAM ENGINE.** In this model, **4 feet long,** all the working parts are of generous proportions and open construction so that every pupil in a large lecture hall will be able to note the essential features. The drive wheel has been omitted. Parts are mounted as illustrated, each part finished or colored to make it stand out clear and distinct **65.00**

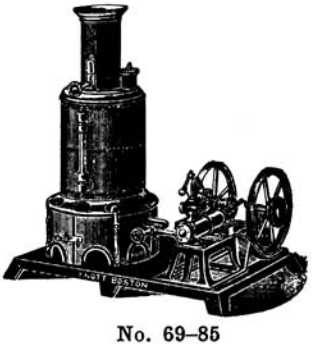


No. 69–55

69–55 **LOCOMOTIVE CHART** — a sectional view of a modern locomotive with all parts numbered. An index gives name of each part. Mounted on heavy cardboard with eyelets for hanging on the wall..... **$4.50**



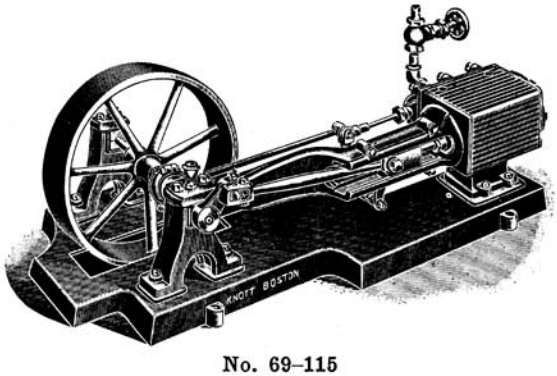
No. 69–75



No. 69–85

69–75 **WORKING STEAM ENGINE** for low pressure such as obtained with Steam Boiler **No. 60–365.** Operates smoothly without load on two inches of mercury pressure. Mounted as illustrated on substantial cast metal base..... **9.25**

69–85 **WORKING STEAM PLANT.** Consists of a small boiler and engine mounted on a common base. Engine runs rapidly and easily..... **8.50**



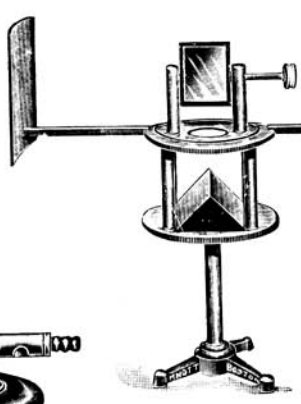
No. 69–115

69–115 **ONE-QUARTER H.P. HORIZONTAL STEAM ENGINE.** With necessary steam pressure this engine will run smoothly and develop ¼ H.P. Cylinder 1⅛×2 inches, bed 12×7 inches, fly wheel 6 inches diameter..... **52.50**

LIGHT

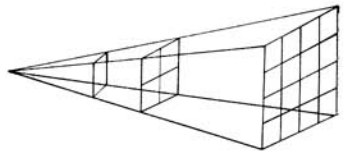
No. 70–90

No. 70–92

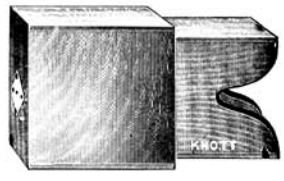


No. 71–10

No. 70–70



No. 71–20



No. 71–30

70–15 **PORTE LUMIERE** for introducing a beam of sunlight (parallel beams of light) into a darkened room and there directing it at option. Constructed entirely of metal. Best quality reflecting mirror, easily adjusted to the movement of the sun. This is an indispensable instrument for a great many experiments requiring parallel rays of light. Can be used also as a " sunlight projector " **$9.50**

70–16 **ADJUSTABLE SLIT DIAPHRAGM** for use with **No. 70–15** for securing a rectangular beam of light **2.25**

70–17 **CYLINDRICAL DIAPHRAGM** for use with **No. 70–15.** With five graded openings for securing pencils of light **2.25**

70–50a **PARAFFINE CANDLES, sixes** (six to the pound) ..... Per dozen **.65**

70–50b **——, twelves** (twelve to the pound) ..... Per dozen **.40**

71–272 **STANDARD CANDLE, sperm,** for use as photometric standard. Six to the pound; will burn 120 grains (7.776 grams) per hour ..... Each **.50**

70–70 **KEROSENE LAMP AND METAL-BOUND ASBESTOS CHIMNEY** for use as a source of light in photometric experiments. The asbestos chimney has a small opening through which a beam of light may pass ..... **.95**

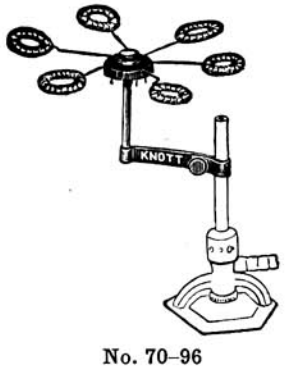
70–72 **KEROSENE LAMP** as used in above — lamp, wick, and glass chimney ..... **.60**

70–73 **METAL BOUND ASBESTOS CHIMNEY** as used in **No. 70–70** **.35**

70–90 **ILLUMINATING GAS BURNER** for use on laboratory table. Tube 12 inches high **1.70**

70–92 **LOW-FORM ILLUMINATING GAS BURNER** for use with optical benches. Curved tube fitted with illuminating tip ..... **.85**

70–96 **MONOCHROMATIC FLAME ATTACHMENT FOR BUNSEN BURNER.** Can be attached in an instant to any Bunsen burner as illustrated. The absorbent ring sponges should be saturated with solutions of various salts — sodium, potassium, lithium, etc. The swiveled head can be turned to obtain the flame desired. Without burner **3.75**



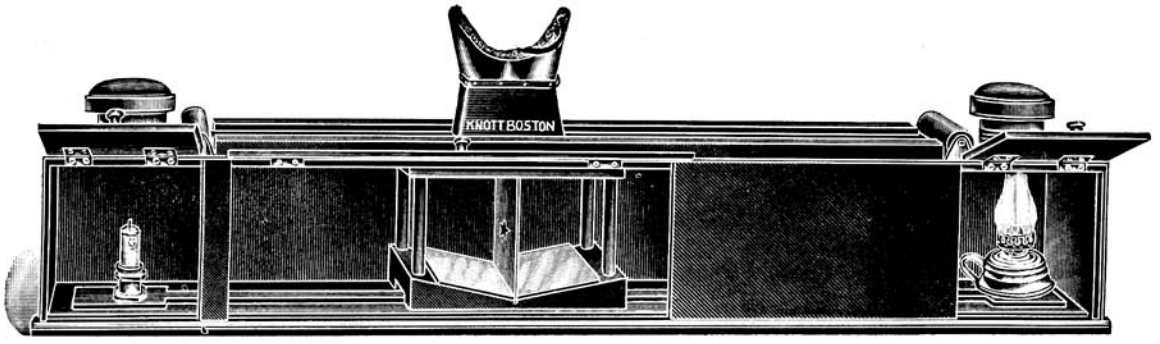
No. 70–96

70–97 **MONOCHROMATIC FLAME ATTACHMENT FOR BUNSEN BURNER, Single Flame Type.** Consists of an absorbent ring sponge attached to a wire which is fastened to a simple spring clamp for clamping to the burner tube. One or more may be clamped to the burner tube at one time and the various wires bent to bring the ring sponge in position as desired **1.50**

71–10 **RITCHIE PHOTOMETER** for lecture room demonstrations in photometry. Light from two different sources falls on the faces of the prism and is reflected by the mirror. The mirror can be tilted and is supported so that it can be turned in all directions so that pupils in all parts of the room may compare the illumination on both faces of the prism. The light shields obstruct rays from the two sources striking on the mirror. Complete as illustrated **18.50**

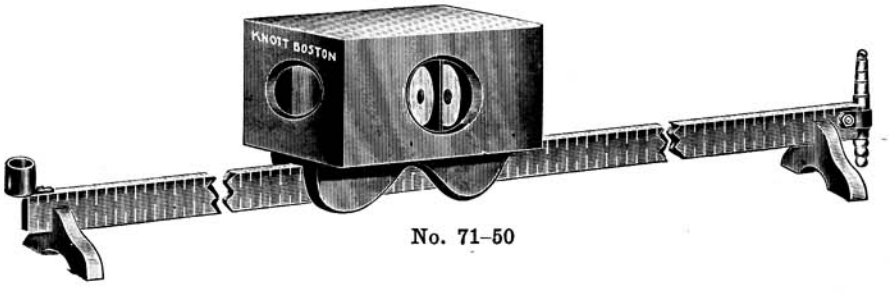
71–20 **INVERSE SQUARES MODEL** for showing that the intensity of the illumination at a surface due to a given source of light is inversely proportional to the square of the distance of the surface from the source of light. The frame is of wire, constructed as shown, with a maximum axis of 8 inches. **2.75**

71–30 **CAMERA OBSCURA or PIN-HOLE CAMERA** for showing images produced through a small aperture. The telescoping box has one end closed by a ground-glass plate for receiving the image. **2.50**



No. 71–40

71–40 LIGHT-ROOM DIBDIN-BUNSEN PHOTOMETER for use in either a darkened or undarkened room in determining the relative intensity of two sources of light. When sources of light are in place, the hinged fronts are dropped and no light except from the two sources can strike the screen. The eyeshade outside the box and screen holder inside the box are designed to move together and are fastened at either end by narrow opaque bands which at either end of the box are wound on spring rollers. Without light sources, but otherwise complete as illustrated **$27.50**



No. 71–50

71–50 STUDENTS' PHOTOMETER for determining the intensity of a source of light. The meter stick supports are of metal, the same as illustrated in group illustration on page 114. The photometer box has an index and is fitted with a Dibdin-Bunsen screen placed between two mirrors set at such an angle that both sides of the screen can be seen simultaneously from the front. With gas burner and candle holder complete as illustrated **6.00**

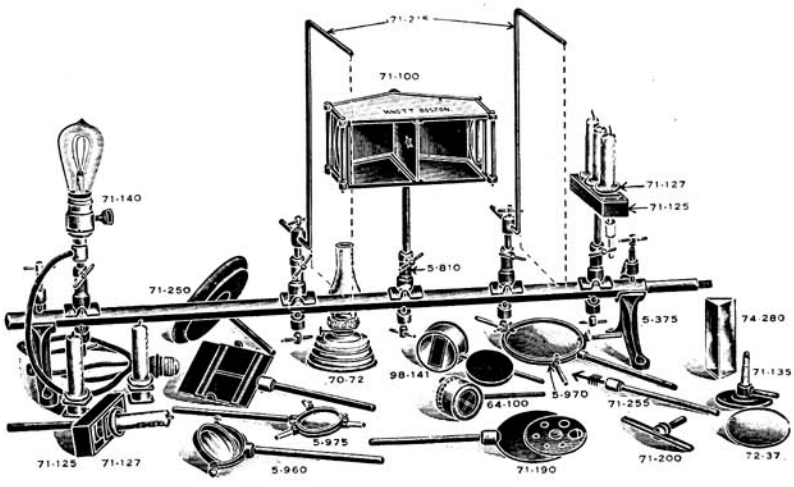
71–52 ELEMENTARY BUNSEN PHOTOMETER. Consists of Meter Stick **No. 11–10,** pair of Meter Stick Supports **No. 71–354,** Bunsen Screen **No. 71–366,** Screen Holder **No. 71–356,** and Candle Holders **Nos. 71–370** and **71–372** **2.68**

71–53 JOLLY PHOTOMETER HEAD (see Fuller and Brownlee, Exp. 37) for use on a meter stick. May be used to replace photometer head of **No. 71–50** or screen and screen holder of **No. 71–52.** See group illustration, page 114 ..... **4.25**

No. 71–60

71–60 RUMFORD'S PHOTOMETER for determining the intensity of a source of light. The two sources of light are placed on the baseboard, one on either side of the light screen. The shadow rod has a light screen on either side to shut off all extraneous light. The screen holder at extreme left is designed to hold an opaque or ground-glass screen. Without screens and light sources, but otherwise complete as illustrated **8.50**

PHOTOMETRIC AND OPTICAL BENCH ATTACHMENTS



71–100 **CAST-ALUMINUM DIBDIN-BUNSEN PHOTOMETER SIGHT BOX on 10-mm. rod.** Cast-metal casing grooved to hold the screen, also the mirrors at proper angle to view both sides of the screen simultaneously. Finished dull black inside and outside..... **$7.25**

71–125 **CANDLE HOLDER TROUGH on 10-mm. rod.** Will carry one to four Candle Holders **No. 71–127** which can be centered almost instantly. Cast metal, dull black finish..... **.95**

71–127 **CANDLE HOLDERS.** These holders are cast with a drip cup and can be used as individual candle holders for the table or any convenient support, or one, two, three or four can be instantly centered in **No. 71–125**.....Each **.30**

71–128 **CANDLE HOLDER FOR ONE CANDLE, on 10-mm. rod**..... **.75**

71–129 **CANDLE HOLDER FOR FOUR CANDLES, on 10-mm. rod**..... **1.20**

70–72 **BRASS KEROSENE LAMP with Wick and Chimney** for use on **No. 71–250**..... **.60**

71–135 **LUMINOUS GAS BURNER.** May be used on **No. 71–250**; especially designed for use inside **No. 71–210**..... **.65**

71–140 **MOUNTED INCANDESCENT LAMP SOCKET on 10-mm. rod.** With cord and Edison plug .. **2.25**

71–142 **MOUNTED WELSBACH GAS BURNER, on 10-mm. rod**..... **2.85**

71–180 **MOUNTED CONVEX GLASS MIRROR (Nos. 5–970 and 72–35)**..... **4.95**

71–182 **MOUNTED CONCAVE GLASS MIRROR (Nos. 5–970 and 72–37)**..... **4.95**

5–960 **ADJUSTABLE PLANE MIRROR ON ROD** (see description, page 12)..... **3.65**

71–190 **SCREEN WITH APERTURES, on 10-mm. rod.** By turning the disc various sizes of holes center over the large hole in the screen..... **5.50**

71–195 **SCREEN WITH ADJUSTABLE VERTICAL SLIT, on 10-mm. rod.** By moving the slides a slit up to one inch wide can be obtained..... **5.75**

71–200 **SCREEN HOLDER, large size, on 10-mm. rod**..... **1.75**

71–205 **SCREEN HOLDER, small size, on 10-mm. rod**..... **1.50**

71–210 **T. & H. BOX WITH WIRE SCREEN** for use in determining the conjugate foci of a converging lens (see National Physics Direction Sheets, Exp. L080). Designed to hold a source of light — **Nos. 70–72, 71–135,** etc. The wire gauze over the opening has been selected to give the best possible definition..... **1.60**

71–215 **MOUNTED BLACK CLOTH EYE SHADES, on 10-mm. rods,** for use on a photometer bench to shield the eyes, also to prevent rays of light from striking on the screen.....Per pair **3.25**

71–225 **GRADUATED CARDBOARD SCREEN, 10 cms. square,** for use with **Nos. 71–200, 71–205,** or **71–356**..... **.10**

71–227 **BLACK OPAQUE SCREEN, 10 cms. square,** for use with **Nos. 71–200, 71–205** or **71–356**..... **.20**

71–230 **TRANSLUCENT (OPALESCENT) SCREEN, 20 cms. square,** for use with **No. 71–200**..... **$0.95**

71–235 **CARDBOARD METRIC SCALES** for use with **No. 71–205** in determining the magnifying power of a converging lens (see National Physics Direction Sheets, Exp. L101).....Per pair **.10**

5–970 **UNIVERSAL LENS HOLDER** for lenses up to 4 inches in diameter (see description, page 12)..... **1.95**

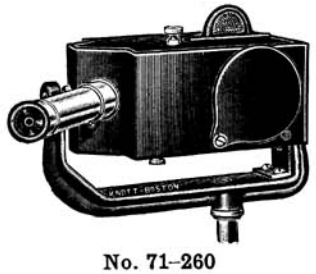
5–975 ——, for lenses up to 2 inches in diameter (see description, page 12). **1.65**

71–250 **TABLE TOP ON ROD** for general use in supporting objects.... **2.45**

71–255 **IMAGE ON ROD,** for use as the " object " in optical experiments. **1.25**

71–260 **LUMMER-BRODHUN PHOTOMETER SIGHT BOX, Contrast Pattern, on 10-mm. rod.** By loosening thumb screw on top, cover may be removed and all working parts exposed to view.... **100.00**

71–272 **STANDARD CANDLE** (see page 111).....Each **.50**



No. 71–260

PHOTOMETRIC AND OPTICAL BENCH OUTFITS

71–327 **UNIVERSAL TWO-METER PHOTOMETRIC OUTFIT WITH GRADUATED ROD.**
1 pair End Supports **No. 5–375**
1 Graduated Two-Meter Square Rod **No. 5–55b**
1 Dibdin-Bunsen Photometer on Rod **No. 71–100**
1 Incandescent Lamp Socket on Rod **No. 71–140**
1 Mounted Welsbach Gas Burner **No. 71–142**
3 Right Angle Clamps **No. 5–810**
Complete **$39.00**

71–327A ——, same as above, but with **Ungraduated Rod No. 5–50f** **27.90**

71–329 **UNIVERSAL ONE-METER PHOTOMETRIC OUTFIT WITH GRADUATED ROD,** same as **No. 71–327,** but with **Graduated Rod, one meter long, No. 5–55a** **33.00**

71–329A ——, same as above, but with **Ungraduated Rod No. 5–50d** **24.25**

71–331 **UNIVERSAL TWO-METER PHOTOMETRIC OUTFIT WITH GRADUATED ROD.**
1 pair End Supports **No. 5–375**
1 Graduated 2-Meter Square Rod **No. 5–55b**
1 Dibdin-Bunsen Photometer on Rod **No. 71–100**
1 pair Eye Shades **No. 71–215**
1 Candle Holder Trough **No. 71–125**
4 Candle Holders **No. 71–127**
1 Mounted Incandescent Lamp Socket **No. 71-140**
5 Right Angle Clamps **No. 5–810**
Complete **45.25**

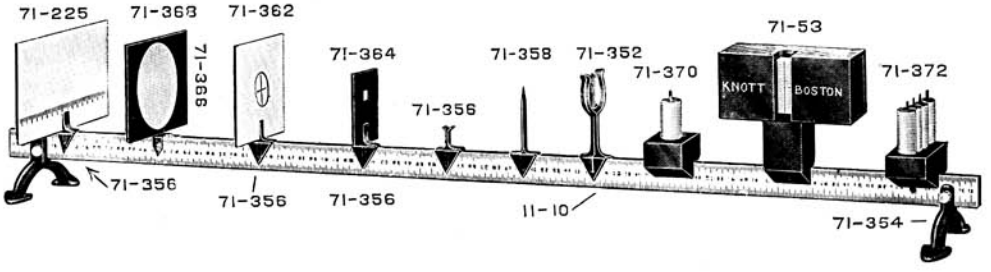
71–331A ——, same as above, but with **Ungraduated Rod No. 5–50f** **34.15**

71–332 **UNIVERSAL ONE-METER PHOTOMETRIC OUTFIT WITH GRADUATED ROD,** same as **No. 71–331,** but with **Graduated Rod, one meter long, No. 5–55a** **39.25**

71–332A ——, same as above, but with **Ungraduated Rod No. 5–50d** **30.50**

71–340 **OPTICAL BENCH ATTACHMENTS,** suggested for addition to any of the above outfits. Consists of **No. 71–200** Screen Holder, **No. 71–225** Graduated Cardboard Screen, **No. 71–227** Black Opaque Screen, **No. 71–230** Translucent Screen, **No. 71–255** Image on Rod, and **No. 5–970** Lens Holder. Complete **6.20**

SIMPLE PHOTOMETRIC AND OPTICAL BENCH ACCESSORIES



71–350 **STUDENT'S OPTICAL BENCH** — a simple outfit for optical experiments. Consists of **No. 11–10** Meter Stick, **No. 71–352** Lens Holder, **No. 74–121** Convex Lens, **No. 71–358** Pin Holder, **No. 71–356** Screen Holder, **No. 71–225** Cardboard Screen, and one pair **No. 71–354** Metal Meter Stick Supports. Complete **2.25**

11–10 **METER STICK** ..... **.45**

71–352 **LENS HOLDER** ..... **.20**

71–354 **METAL METER STICK SUPPORTS.** ..... Per pair **.75**

71–355 **WOOD METER STICK SUPPORTS.** ..... Per pair **.35**

71–356 **SCREEN HOLDER** ..... **.18**

71–225 **GRADUATED CARDBOARD SCREEN** ..... **.10**

71–358 **PIN HOLDER** ..... **.18**

71–362 **OPAQUE SCREEN WITH CROSSED TRANSLUCENT SQUARE OPENING** (see Fuller & Brownlee, Exp. 40) ..... **.35**

71–364 **BLACK AND WHITE OPAQUE SCREEN WITH SQUARE OPENING** (see Fuller & Brownlee, Exp. 48) ..... **.35**

71–366 **BUNSEN SCREEN,** simple form, for use in Holders **No. 71–356** and **71–368** ..... **.25**

71–368 **SCREEN HOLDER** (see National Physics Direction Sheets, Exp. L011) ..... **.75**

71–370 **CANDLE HOLDER FOR ONE CANDLE** (see National Physics Direction Sheets, Exp. L011) ..... **.40**

71–372 **CANDLE HOLDER FOR FOUR CANDLES** (see National Physics Direction Sheets, Exp. L011) **.65**

71–375 **BLOCK AND BENT WIRE** for finding real and virtual images in a lens ..... **.35**

71–376 **WIRE BENT AT RIGHT ANGLES** (see Hall **No. 73**) ..... **.05**

71–380 **CARDBOARD DIAPHRAGM WITH 1-CM. OPENING** (see National Physics Direction Sheets, Exps. L101 and L105) ..... **.10**

71–400 **CULLER'S PRINCIPLE FOCUS BOX** (see Culler, Exp. XXXV) **3.45**

71–500 **MOUNTED CONVEX LENS AND WIRE SCREEN** (see Millikan, Gale & Bishop, Exp. 46). **1.85**

REFLECTION OF LIGHT

Nos. 72–10 to 72–45

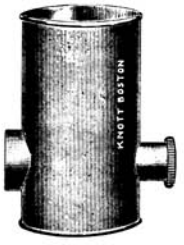
No. 72–60

No. 72–70

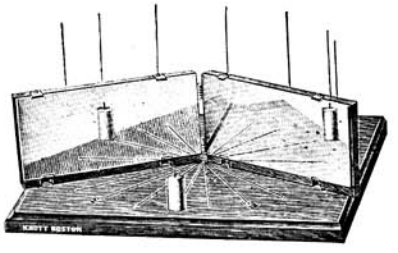
No. 22–145

No. 72–90

No. 72–100



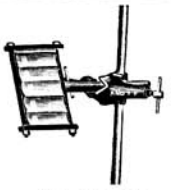
No. 72–125



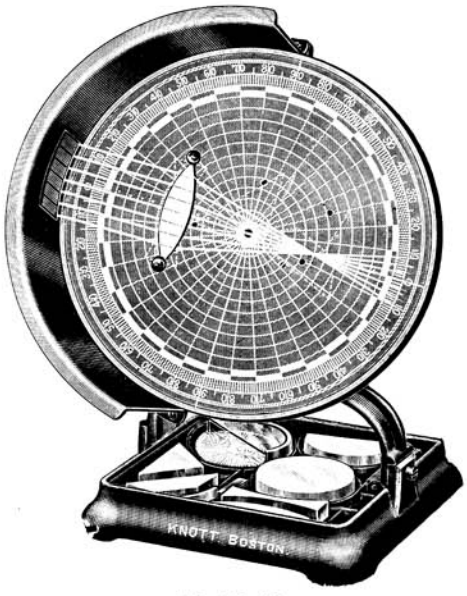
No. 72–95

72–10	**PLANE GLASS MIRROR, 6×2 inches,** silvered back	$0.15
72–10a	**SPRING BRASS CLIPS** for holding mirror to a block.	Pair .25
72–10b	**VERTICAL INDEX BLOCK, white face** (see Hall No. 66)	.20
72–12	**PLANE GLASS MIRROR, 6×4 inches,** silvered back	.25
72–15	**PLANE GLASS MIRROR, lacquered black on one side** (see Millikan, Gale & Bishop, Exp. 42)	.20
72–20	**CONCAVE-CONVEX CYLINDRICAL MIRROR,** brass, heavily nickeled and burnished	.75
72–25	**CONCAVE-CONVEX SPHERICAL MIRROR, 3 inches diameter, 6 inches focus.** Brass, heavily nickeled and burnished	.75
72–35	**CONVEX GLASS MIRROR, 3 inches diameter, 6 inches focus,** silvered back protected	3.00
72–37	**CONCAVE GLASS MIRROR, 3 inches diameter, 6 inches focus,** silvered back protected	3.00
72–45	**MOUNTED CONCAVE AND CONVEX GLASS MIRRORS, 4½ inches diameter,** mounted in circular wooden frame with handle	4.25
72–60	**IMPROVED INCIDENCE AND REFLECTION APPARATUS** for determining the law of reflection of light. In use, one arm is set at any desired position. Sighting across the second, this arm is moved until the image of the first and the etched line of the mirror and the sighting edge of the second are in the same straight line. If the positions of these index arms are noted on the graduated arc it will be found that the angle of incidence is equal to the angle of reflection	6.50
72–70	**GAGE'S REFLECTION APPARATUS** for demonstrating the law of reflection of light. By glancing in the mirror through the hole marked " O " an image only of the hole is seen. If the source of light is held before any of the other holes the image in the mirror can be seen only through the hole equally distant on the other side of the normal to the mirror	4.25
22–145	**INCIDENCE AND REFLECTION APPARATUS** (see description, page 44)	19.00
72–90	**MULTIPLE REFLECTION APPARATUS** for study of multiple reflections. Metal construction throughout. Mirrors may be unhinged from center and mounted parallel to each other	9.50
72–95	**PLACED IMAGE MULTIPLE REFLECTION APPARATUS** for study of multiple images (see Hall & Bergen's " A Text-Book of Physics," page 158). In use the mirrors are placed upon the board with the reflecting surfaces making an angle of 90° — in the position as illustrated. The lighted candle should be of such height that its flame will not be above the upper edge of the mirrors and should be exactly over the middle hole in front of the board. The positions of the images of the candle should now be noted and pegs placed in the holes behind the mirrors in such a position that, to an observer placed in front of the mirrors, the images in the mirrors and the pegs over the mirror will appear to coincide. The experiment should be modified with the mirrors also at angles of 60° and 30°	5.75
72–100	**KALEIDOSCOPE.** Three mirrors are mounted separately in metal frames and then combined to form a case with the mirrors at angles of 60°. One end is closed by a disc of ground glass, the other is provided with a cap with an aperture. Fragments of colored glass are placed at one end between the ground-glass discs and the second clear-glass disc. The objects and their images when viewed through the aperture present themselves in an endless variety of symmetrical forms as the kaleidoscope tube is turned	4.20
72–105	**STUDENTS' KALEIDOSCOPE,** similar in design to above but of more simple construction	.75
72–125	**LUMINOUS CASCADE** for showing total reflection by means of a jet of water. A strong parallel beam of light is directed into the glass window at the left so that it will pass through the small orifice in the tube at the left. If the vessel is filled with clear water it will issue from the small orifice and will be illuminated for a considerable distance. Colored-glass plates placed before the window make a pleasing modification of the experiment	16.50

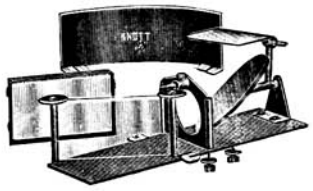
No. 73–75



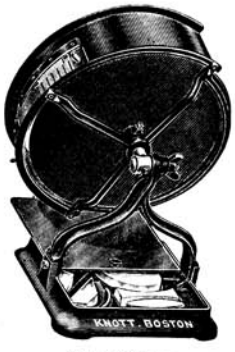
No. 73–50



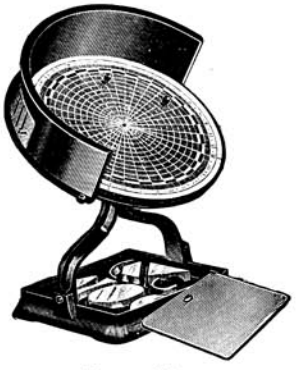
No. 73–10



No. 73–80



Rear View
Wing Nut Loosened
Permits of Tilting



Front View
Dial Tilted

73–10 **KOLBE-HARCOURT OPTICAL DISC, self-contained, universal inclination,** for illustrating in a simple direct manner the fundamental laws in optics. Rays of sunlight, direct or reflected, will show as white paths of light across the face of the dial. When a prism, lens, or mirror is placed in these rays of light there results refraction or reflection as will be indicated by the paths which will show on the face of the dial. The instrument has been designed for use in a lecture hall and the results are clear and positive, even to those pupils in the rear of the hall. We have retained in our new model the optical perfections of previous designs, but have greatly enhanced the value of the instrument by mechanical improvements which may be noted in our illustrations. We can obtain any conceivable angle of tilt for the dial, rotate shield and dial independently of each other, and provide an individual pocket for each optical part in the base of the instrument. Many experiments are possible with the optical disc. On the next page we illustrate a few. A special pamphlet describing these and other experiments will be sent upon request. Complete with all optical parts **$36.00**

73–50 **DIVERGING RAY ATTACHMENT.** Consists of a system of concavo-cylindrical lenses mounted with rod for clamping to a support stand. Each individual lens sends out a bundle of diverging rays, and one ray from each lens will pass through the slit in the screen, forming a system of diverging rays which appear to come from the slit as a source and cross the face of the dial. Attachment only, without clamp or support stand **9.75**

73–75 **REFRACTION OF WATER TANK.** Fastens to the center of the dial of the optical disc. The glass front covers slightly more than one-half the circle so that the water level can be used at the 90-90 mark **8.25**

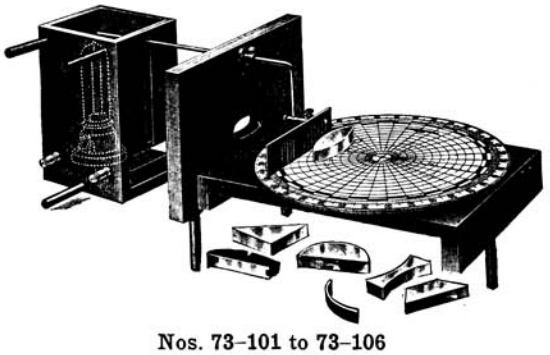
73–80 **POLARIZED LIGHT ATTACHMENT.** This attachment in use is clamped to the face of the optical disc by means of thumb screws. It is used in studying the fundamental phenomena of polarized light, uniform reflection of ordinary unpolarized light, polarization by reflection, polarization by multiple refractions, chromatic polarization, and many other important phenomena that readily suggest themselves when the attachment is in use **18.75**

73–90 **COWEN'S N. AND F. APPARATUS** for use on the face of the optical disc to illustrate near and far-sightedness. Will be found a valuable accessory **1.50**

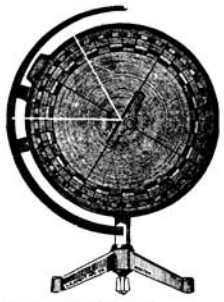
73–101 **HARCOURT IMPROVED STUDENTS' OPTICAL DISC** for use in horizontal position only (see National Physics Direction Sheets, Exps. L110 to L118). Without optical parts, but otherwise complete as illustrated, with special light box and complete series of direction sheets **$22.00**

73–102 **OPTICAL DISC LIGHT PARTS.** One set will be found ample for four groups of pupils working with **No. 73–101.** In box **9.50**

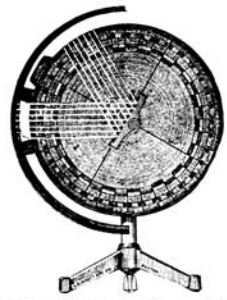
73–106 **HERSEY'S 110-VOLT LIGHT BOX** for general laboratory use as a source of light **6.50**



Nos. 73–101 to 73–106

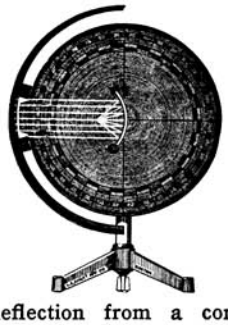


A ray reflected from a plane mirror. Angle of incidence equal to angle of reflection.

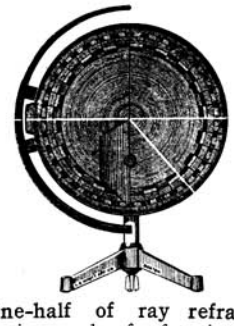


Reflection from a plane mirror. Incident parallel rays are reflected parallel.

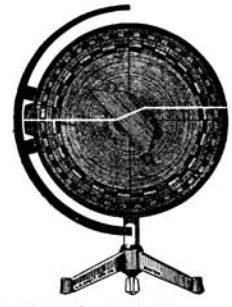
Reflection from a convex mirror. Showing divergence of rays.



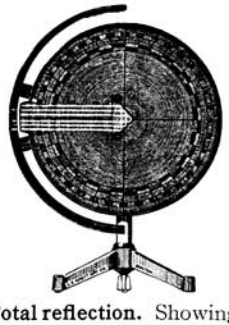
Reflection from a concave mirror. Showing convergence of rays.



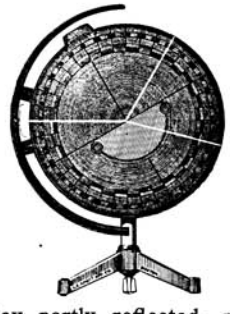
One-half of ray refracted. Showing angle of refraction.



Angle of deviation — minimum angle of deviation. Showing an incident ray emerging parallel, since surfaces are parallel.

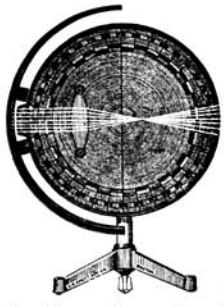


Total reflection. Showing rays totally reflected at the hypothenuse and reversed upon emerging.

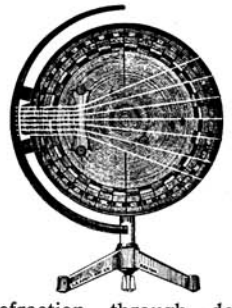


Ray partly reflected, partly refracted. Showing angle of incidence and refraction.

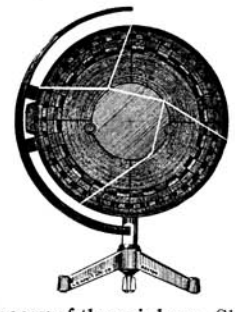
Ray totally reflected. By turning disc, critical angle may be determined.



Refraction through double convex lens. Showing convergence of rays.



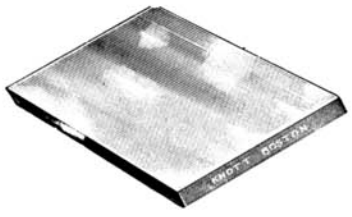
Refraction through double concave lens. Showing divergence of rays.



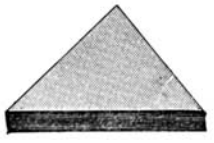
Theory of the rainbow. Showing the "primary bow."

Send for Special Pamphlet describing experiments suggested above in diagram.

REFRACTION OF LIGHT



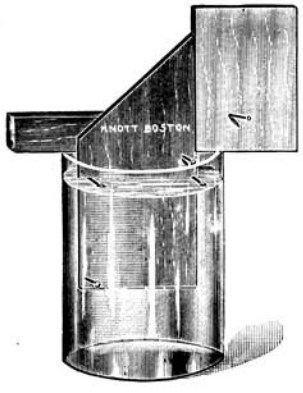
No. 74–50



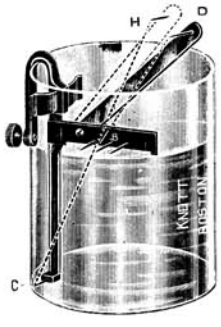
No. 74–55

74–50 GILLEY INDEX OF REFRACTION PLATE, 3×4 inches, polished edges, for determining the index of refraction of glass **$0.60**

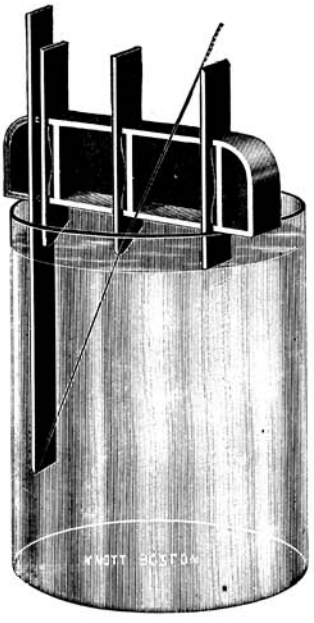
74–55 EQUILATERAL PRISM (see Millikan, Gale & Bishop, Exp. 43). A triangular prism of heavy plate glass, 75 mm. polished edges, one surface ground ..... **.65**



No. 74–75



No. 74–85



No. 74–90

74–75 GILLEY INDEX OF REFRACTION OF WATER BOARD for determining the index of refraction of water. Made of selected soft wood, impregnated with paraffine. Pins are used to determine water level and the line of sight. Without jar **1.25**

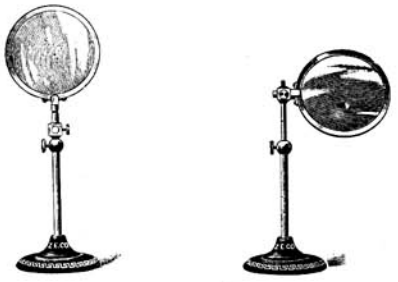
31-265c GLASS JAR, 6×8 inches, for use with above ..... **.60**

74–81 BRASS PARTITION with attached clamps (see Hall & Bergen Exp. 25 (No. 29) ..... **.35**

74–82 BRASS CLAMPS with index points. (See Hall & Bergen, Exp. 25 (No. 30) .....Each **.30**

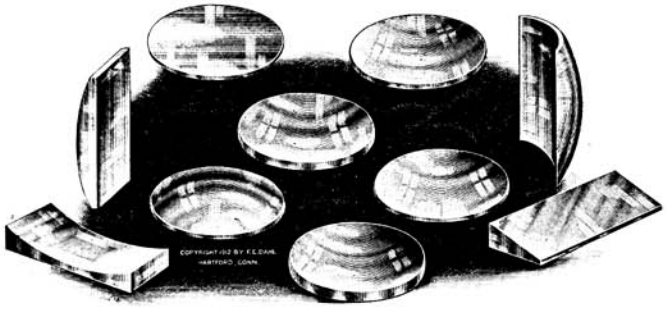
74–85 INDEX OF REFRACTION OF WATER APPARATUS WITH ADJUSTABLE SIGHTING ARM. (See Culler's " Laboratory Manual of Physics," Exp. XXXIV.) Can be used on round or square jar. An important feature is that the results can be transferred to the notebook page by removing the apparatus from the jar and pressing the needle points down into the blank sheet. Without jar **2.85**

74–90 PRATT INSTITUTE INDEX OF REFRACTION OF WATER APPARATUS. The metal sliding index strips are held adjustably in the non-corrosive cast metal support. When the line of sight is obtained the apparatus is taken from the jar and the straight edges placed on a sheet of paper and the line of sight drawn. Index of refraction is then determined by ordinary methods. Without jar.. **5.60**



No. 74–210

No. 74–230



No. 74–107

74–107 DEMONSTRATION LENSES, 3 inches diameter. A set of 10 lenses, one each of the following types: Double-convex, double-concave, plano-convex, plano-concave, cylindrical-convex, cylindrical-concave, sphero-cylindrical, sphero-prismatic, periscopic-convex, periscopic-concave ..... Set **$15.00**

74–110 DEMONSTRATION LENSES, 2 inches diameter. A set of 6 lenses, one each of the following types: Double-convex, double-concave, plano-convex, plano-concave, periscopic-convex, periscopic-concave ..... Set **4.50**

74–112 ——, 1½ inches diameter. Set of 6 lenses, same as above, enclosed in cardboard box ..... Set **2.50**

LABORATORY LENSES

DOUBLE-CONVEX LENSES, highest quality, carefully polished, ground edges.

No.	74–118	74–120	74–121	74–121a	74–122	74–122a
Diameter, inches	1½	1½	1½	1½	2	2
Focus, inches	2	4	6	8	5	20
Each	**$0.65**	**.50**	**.40**	**.50**	**.65**	**.75**
No.	**74–123**	**74–124**	**74–125**	**74–126**	**74–126a**	
Diameter, inches	2½	3	4	4	5	
Focus, inches	6	7	10	16	10	
Each	**$0.80**	**1.15**	**2.00**	**2.25**	**2.75**	

74–150 DOUBLE-CONCAVE LENS, 1½ inches diameter, 6 inches focus, highest quality, ground edges **$0.45**

74–151 ——, 1½ inches diameter, 8 inches focus ..... **.45**

74–152 ——, 2 inches diameter, 8 inches focus ..... **.60**

74–153 ——, 3 inches diameter, 6 inches focus **1.60**

74–170 CONDENSING LENS, plano-convex, 4½ inches diameter, 6½ inches focus, ground edges **2.45**

74–171 ——, 4½ inches diameter, 10 inches focus **2.45**

74–172 ——, 5 inches diameter, 8 inches focus **3.85**

74–173 ——, 6 inches diameter, 10 inches focus **4.75**

74–180 WATER LENS, hollow plano-convex vessel, with opening for introduction of water. Diameter 80 mm **4.50**

74–182 WATER LENS, hollow double-convex vessel, with opening for introduction of water. Diameter 80 mm **5.50**

74–192 ACHROMATIC LENS, diameter 2 inches, focus 8 inches. Two lenses, a diverging concavo-convex flint glass lens and a double-convex crown glass lens, accurately ground and polished and perfectly fitted to each other **10.75**

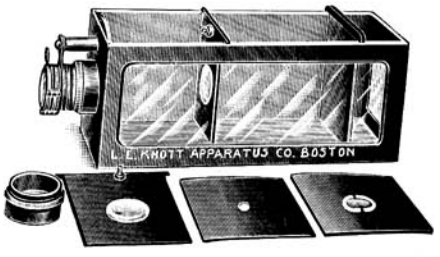
74–210 MOUNTED CONDENSING LENS, diameter 5 inches, focus 8 inches. The stand is of brass and of a design constructed to facilitate in obtaining all positions desired for the lens in laboratory practice. Complete as illustrated **12.00**

74–215 MOUNTED DOUBLE-CONVEX LENS, diameter 4 inches, focus 14 inches. Mounted in Holder **No. 5–970,** adjustably supported on a metal stand **12.00**

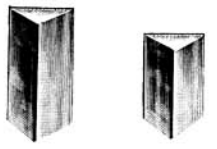
74–230 READING LENS, diameter 3 inches. A double-convex lens mounted in a metal frame and provided with handle **2.00**

74–231 LONG FOCUS LENS with handle **1.50**

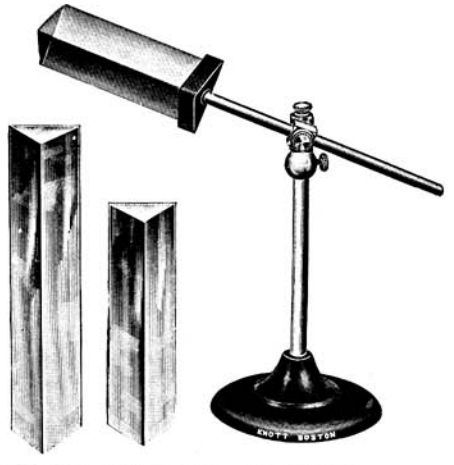
74–235 POCKET MAGNIFIER (LINEN TESTER) ½ inch aperture. A small double-convex lens, short focus, mounted in a brass piece that may be folded into small compass ..... **.60**



No. 74–240



No. 74–297 No. 74–295



No. 74–450

No. 74–480

No. 74–307

No. 74–315

No. 74–430

No. 74–282 No. 74–280

74–240 **KUEHNE'S EYE MODEL** for the demonstration and study of the optical construction of the eye, its normal and abnormal condition and the necessary corrections. The apparatus consists of a water-tight rectangular box with various accessories, such as the two corneas, one of which is fitted with a cylindrical lens, two eye lenses of different foci, three diaphragms, retina and six glasses to be used in front for correcting errors. Apparatus complete as above described, including full instructions for use **$55.00**

6201 **MODEL OF HUMAN EYE** of plaster of Paris. Dissectible **12.50**

74–280 **EQUILATERAL PRISM,** flint glass, square ends, 30-mm. face, 4 inches long **$1.50**

74–282 **——, 6 inches long** **2.00**

74–295 **EQUILATERAL PRISM,** crown glass, square ends, 25-mm. face, 1½ inches long ..... **.75**

74–297 ——, 2 inches long **1.00**

74–305 **RIGHT ANGLE PRISM** for total reflection, angles of 45 and 90°, sides 25 by 25 mm., length 1½ inches **1.00**

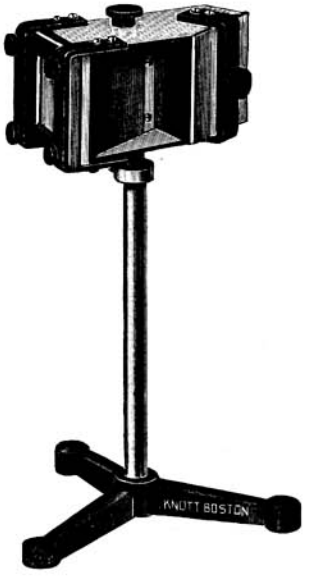
74–307 ——, angles of 45 and 90°, sides 38 by 38 mm., length 2 inches **1.65**

74–315 **FLINT GLASS PRISM,** refracting angle of 20°, sides 41 mm., length 1½ inches **1.50**

74–430 **IMPROVED CAST HOLLOW PRISM.** The design illustrated above pictures our new model hollow prism, indestructibly constructed of cast metal with openings in two sides closed in an ingenious manner by optical plate glass. This prism will be found adequate for most laboratory work, and results are entirely satisfactory. It is finished with a durable dull black coating **9.25**

74–450 **MOUNTED EQUILATERAL PRISM.** This is a 4-inch equilateral prism, mounted on the Hall Universal Stand as illustrated. This stand can be raised and lowered to any desired height or inclined to any angle. It is handsomely finished and the base offers a substantial support **8.50**

74–452 ——, similar to above, but **prism 6 inches long** **10.00**



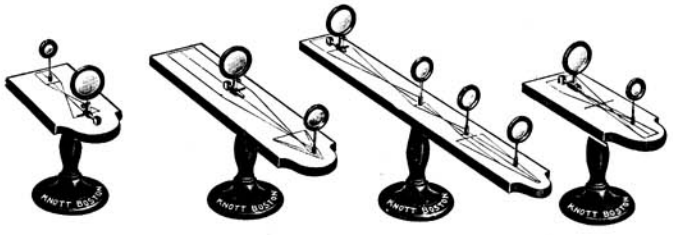
No. 74–470

74–455 **MOUNTED TOTAL REFLECTION PRISM,** consisting of a right angle prism, flint glass, angles of 45° and 90° mounted on stand as illustrated in **No. 74–450** **9.00**

74–470 **DIRECT VISION PRISM,** after the original specifications of the late Mr. Eaton of Brooklyn, N. Y., for projection of spectra on a screen. This prism consists of a combination of two prisms, one of dense glass, the other a hollow prism which in use is filled with carbon bisulphide, the angles of each of which are very nicely calculated, giving a direct vision spectrum of large dispersion. At a distance of 20 feet from the screen, with a ¼-size objective, it is possible to secure a clear spectrum band 6 feet long by 2 feet wide. Mounted on rod telescoping into neat tripod stand ... **$55.00**

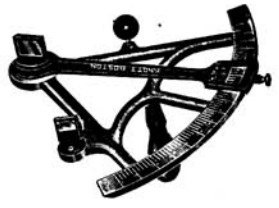
74–480 **POLYPRISM** for illustrating the phenomena of multiple refractions. The polyprism is set into a cylindrically-shaped wooden holder provided with an aperture for viewing an object through the polyprism ..... **.50**

OPTICAL INSTRUMENTS



No. 75–154 No. 75–151 No. 75–152 No. 75–150

No. 75–30



No. 75–165

75–30 **ACHROMATIC TELESCOPE,** extra quality, morocco-covered body, polished brass slides, cap for object glass and sliding cover for eye lens. Length, closed, 5½ inches, three draws to 14 inches long, magnifying power 12 diameters **$5.25**

MODELS OF OPTICAL INSTRUMENTS

These models consist of lenses mounted in holders appropriately placed for the best definition. The holders are mounted on a cross-head attached to a neatly finished wood stand. The paths which the rays take are sketched on the flat face of the cross-head. These models will be found instructive and as the magnification and definition are excellent they will be found of great utility.

75–150 **GALILEO'S TELESCOPE MODEL,** comprising two lenses, the object glass, and a diverging or double concave eye-piece. This instrument illustrates the common opera glass, giving an erect image **$9.00**

75–151 **ASTRONOMICAL TELESCOPE MODEL,** consisting of two lenses, one the condensing eye-piece and the other the object glass. In comparison with **No. 75–154,** Model of the Microscope, it will be seen that this astronomical telescope is analogous to the microscope, differing in the respect that in the microscope, the object being seen through the object glass, the image formed must be on the principal focus and is, therefore, greatly magnified, so that both the object glass and the eye-piece magnify; while in the astronomical telescope, the heavenly body being at a great distance, the rays are parallel and the image formed on the principal focus of the object glass is much smaller than the object. There is, therefore, little magnification except that secured by the eye-piece, which usually is of short focal length. The lines which represent the path of the rays bring this out very clearly in object models **12.75**

75–152 **TERRESTRIAL TELESCOPE MODEL,** consisting of two condensing lenses placed between the object glass and the eye-piece. It will be noted that this telescope differs from the astronomical telescope in that it produces images in their right positions **14.50**

75–153 **TELESCOPE MODELS,** as listed above, showing the construction of the principal telescopes. Set of three **36.25**

75–154 **MICROSCOPE MODEL,** consisting of two lenses, one the objective, the other the eye-piece **9.00**

75–155 **DEMONSTRATION MICROSCOPE** (see Millikan, Gale & Bishop's "Laboratory Physics," Exp. 49), for determining the magnifying power of a microscope. The apparatus consists of a brass tube, on either end of which are placed corks with apertures. Over one end is fastened a linen tester, **No. 74–235.** Apparatus complete with two linen testers **1.90**

75–161 **RULED CARDBOARD STRIP** (see Fuller & Brownlee, Exp. 49A) ..... **.45**

75–163 **CARDBOARD INDEX STRIP** (see Fuller & Brownlee, Exp. 49A) ..... **.30**

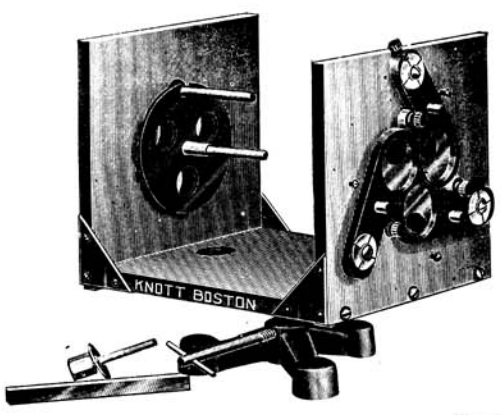
75–165 **SEXTANT,** for measuring the angle between any two distant objects. This is a universal, durably constructed aluminum model, divided on main scale to read to degrees. The vernier on index arm is graduated so that six divisions on vernier equal five on the main scale. This model must not be confused with a number of cheap models at present on the market, as this is an accurate working instrument provided with most of the adjustments of an engineer's and mariner's expensive metal sextant **45.00**

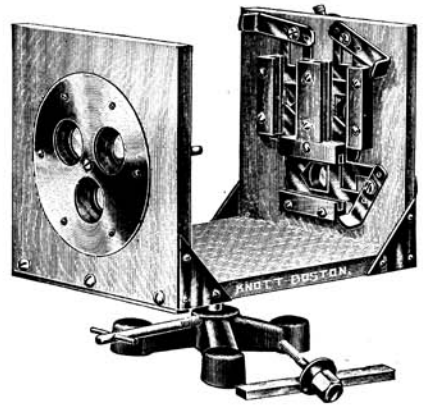
77–90 **COLORED GLASS PLATES** for analysis and study of light. They are furnished 10 cms. square in the following colors: red, orange, yellow, green, blue, indigo and violet. Per set of seven colors. **2.75**

THE VON NARDROFF COLOR APPARATUS

DESIGNED FOR THE STUDY OF COLOR PHENOMENA

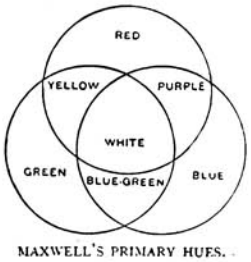
An Attachment for the Projection Lantern or Porte Lumiere
Made under the personal supervision of Mr. F. W. Huntington



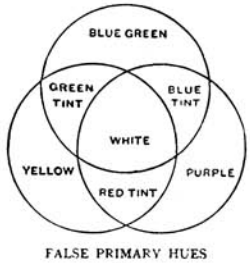


No. 77–100

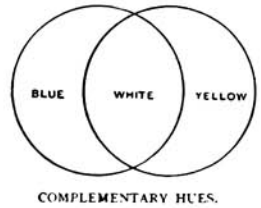
77–100 VON NARDROFF COLOR APPARATUS. This apparatus was designed by Dr. Von Nardroff, principal of the Stuyvesant High School, New York City, for the convenient and satisfactory study of color phenomena where only one projection lantern is available. Our method of mounting is such that it is equally well adapted for use with the porte lumiere. Briefly, it is an attachment that converts an ordinary projection lantern into a triple lantern in which each of the three beams of light is independent both as to intensity and direction. The general form and design is clearly indicated by the cuts above, showing two positions.



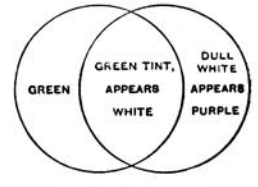
MAXWELL'S PRIMARY HUES.
Fig. 1.



FALSE PRIMARY HUES
Fig. 2



COMPLEMENTARY HUES.
Fig. 3.



CONTRAST EFFECTS.
Fig. 4.

EXPERIMENTS

A Study of Primaries and Secondaries (see Fig. 1). The red, green, and blue glasses provided with the apparatus are placed in the glass holders shown in the diagram. By a movement of the lens arm these circles of red, green, and blue may be overlapped either in whole or in part as desired and, by means of the diaphragms, the intensity of strength of each color readily regulated. The effect of mixing the primaries in any desired portion, in pairs or in triples, is readily seen.

False Primaries (see Fig. 2). In this illustration the glasses selected should be the purple, yellow and blue-green, and by proper manipulation of the diaphragms all possible hues, as well as white, may be obtained.

Complementary Hues (see Fig. 3) are easily illustrated by carefully choosing the pairs of colored glasses to obtain the desired results.

"The Green Question" is solved by superimposing the yellow and blue glasses in the single slide holder of the apparatus and again inserting the same glasses in separate slide holders, adding the beams by overlapping on the screen, noting that a pure white light is obtained.

Contrasting Effects (see Fig. 4) are strikingly illustrated when a saturated color, such as green, is projected and the white disc arranged to partially overlap turned on; the overlap, which is really a tint, appearing nearly white, while the remaining white appears strongly colored of the complementary hue. If the order of projection is reversed, the sudden appearance of the white is very impressive.

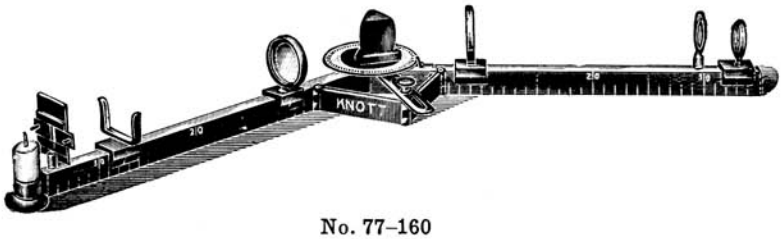
A Study of Tints is easily made by adding to the white beam a colored beam adjusted for intensity.

Other Experiments. Many additional experiments will suggest themselves to the user after he has become familiar with the apparatus and commences to learn some of its possibilities; such, for instance, as three equally bright beams being made to partially overlap. The remaining portions of the beams will present intensities as the ratio of 1:2:3. Again, projecting on the screen a compound white, holding an opaque body in the path of the ray, a very remarkable shadow effect will be produced.

Price mounted as illustrated, $45.00

SPECTRAL APPARATUS

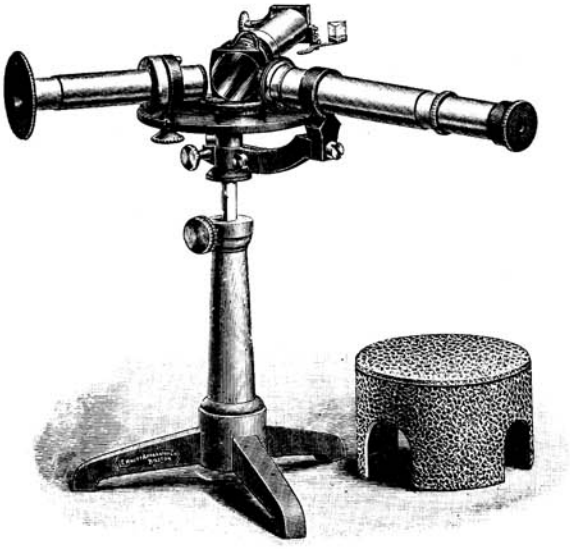
No. 77–125



No. 77–160

77–125 DIRECT-VISION POCKET SPECTROSCOPE for use in experiments in spectrum analysis. This instrument consists of a combination of three prisms giving a considerable dispersion. It will show many of the Frauenhofer lines, the bright lines of the metals and gases and the absorption bands in colored gases, crystals, or liquids. It is provided with an adjustable slit operated by a small micrometer screw. This spectroscope has an achromatic lens and is of excellent quality throughout. Enclosed in velvet-lined case **$19.75**

77–160 DEMONSTRATION SPECTRAL APPARATUS AND GONIOMETER, a goniometer or spectrometer of simple design but accurate construction, in which all lenses, diaphragms and slit are separately mounted and arranged for adjustment along nickel-plated graduated metal bars. The prism table and circle is accurately divided on metal to two degrees. Although primarily designed for demonstration purposes, it will be found of unusual value as a student's instrument, in that the student is enabled, not only to use the instrument as a spectral apparatus with a fair degree of accuracy, but also to use it with a correct understanding of construction of telescope and collimator and, from observation of correct position of parts arranged openly on this simple design, clearly to understand the more complex instruments. Constructed of metal throughout, handsomely nickel-plated and oxidized. Complete with holders, slit and lenses, but without prism **45.00**



No. 77–170

77–170 ADVANCED SPECTROSCOPE. This instrument is especially designed for high school and elementary college work It is furnished completely equipped with all essential parts. All mechanical details are well constructed and nicely fitted; all optical parts are of the best. The telescope is adjustable, has an aperture of about 20 mm. and a focal length of about 160 mm. The collimator is provided with a comparison prism and is of the same dimensions as the telescope. A separate tube contains the scale. The instrument is mounted adjustably in a neatly finished tripod stand. It is furnished with a 60-degree flint glass prism provided with a cover. **75.00**

Nos. 77–225 to 77–236

No. 77–245

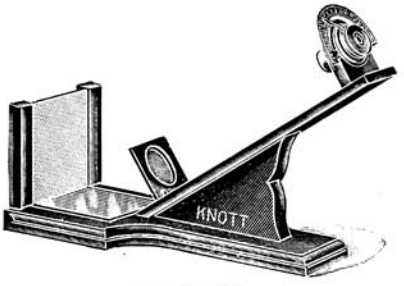
77–225 GEISSLER SPECTRUM TUBE, filled with carbon dioxide **3.00**
77–226 ——, filled with hydrogen gas **3.00**
77–227 ——, filled with nitrogen gas **3.00**
77–228 ——, filled with oxygen gas **3.00**
77–235 GEISSLER SPECTRUM TUBE, most carefully constructed, evacuated, and filled with pure argon gas **4.50**
77–236 ——, same as above, but filled with pure helium **4.50**
77–245 GEISSLER SPECTRUM TUBE for exhausting and filling with whatever gas desired. Fitted with two carefully ground glass cocks **5.25**

77–350 NEWTON'S RINGS for illustrating colors of thin plates, demonstrating interference of light, etc. This apparatus consists of two brass rings between which are locked two glasses, one plane and the other convex, of very long focus. The method of locking the two rings is such that by means of the screws, the pressure may be regulated. Diameter of glasses, 1½ inches. If the two surfaces are exposed to ordinary light in front of the window, so as to reflect light, there is seen at the point of contact a black spot, surrounded by 6 or 7 colored rings, the tints of which become gradually less strong. If the glasses are viewed by transmitted light, the center of the ring is white and each of the colors is exactly complementary to that of the rings by reflection. If exposed to light from a monochromatic flame, an interesting study of the colored rings presents itself. **$3.75**

No. 77–350

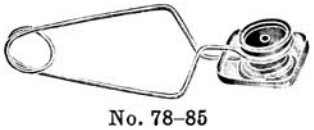
77–375 INTERFERENCE OF LIGHT PLATES (see Millikan & Gale, Fig. 391). . . . . Pair **.75**

POLARIZATION STUDY APPARATUS



No. 78–45

No. 78–95



No. 78–85

No. 78–75

78–45 PICKERING POLARISCOPE for study of simple objects under polarized light. This is a simple form of polariscope in which the polarizing mirror covers the stage. The analyzer is a Nicol's Prism 6-mm. aperture mounted in brass tube. It is provided with pointer and graduated arc. An improved holder is provided for specimens to be studied. **$25.50**

Iceland Spar. Iceland Spar is a crystallized mineral which produces two refracted beams of light from one incident ray. Iceland Spar comes in many forms, all of which may be reduced by cleavage to the rhombohedron. This mineral comes in many grades of purity and clarity, although the double refraction can be shown by the quality readily obtainable, and as generally listed. We recommend our **No. 78–75.**

78–75 ICELAND SPAR, best quality, recommended for its remarkable purity and clarity. **1.20**

78–76 ICELAND SPAR, large size, medium quality. . . . . **.60**

78–77 ICELAND SPAR, ordinary quality. . . . . **.35**

Tourmaline Tongs. Tourmaline is a uni-axial negative crystal in the form of a regular hexagonal prism from which only the "extraordinary" ray emerges, while the "ordinary" is rapidly absorbed. It can, therefore, be used in producing a polarizing light. The optical axis of tourmaline coincides with the prism and for optical purposes the plate is cut from it parallel to the axis. In tourmaline tongs used for illustrating and analyzing polarized light, two tourmaline crystals are mounted in discs which are held as illustrated. These discs are each free to move. If the prisms are placed so that their axes are parallel, light emerges as the prisms are turned so that their axes are at an angle. In use, the crystal to be studied under polarized light is placed between the two crystals.

78–85 TOURMALINE TONGS, simple form, medium size tourmaline prisms, capable of ordinary work. . . **5.00**

NICOL'S PRISMS

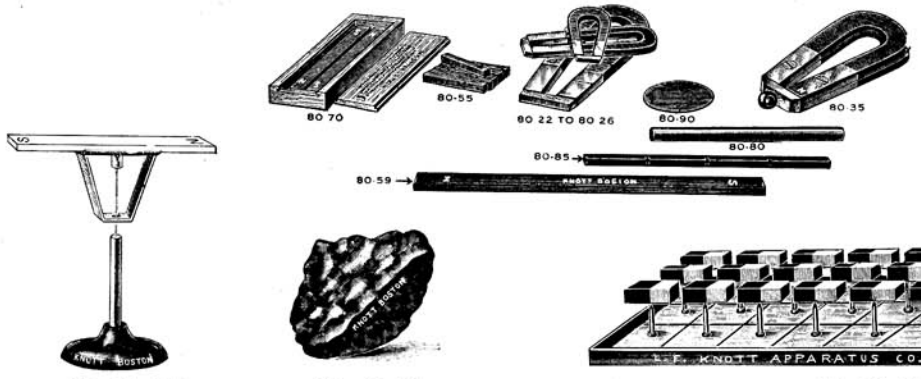
The ray of light incident on the crystal of Iceland Spar is split into two rays, the "ordinary" and the "extraordinary," each of which travels in a different plane. In order that the incident ray may be transmitted in one plane it is necessary to dispose of either the "ordinary" or "extraordinary" ray. The Nicol's Prism causes the "ordinary" ray to be totally reflected, allowing the free transmission of the "extraordinary" ray.

These types of prisms consist of rhombs of Iceland Spar, each of which is obliquely cross-cut symmetrical to the other. Faces polished and then luted by the cement the index of refraction of which is greater than that of the "extraordinary" ray. This cross cut is of such an angle that total reflection of the "ordinary" ray occurs when the incident ray strikes the luted faces. Our Nicol's Prisms are purchased from one manufacturer and are noted for their large polarizing field and their exceeding clarity.

78–95 NICOL'S PRISMS, luted by Canada Balsam, polarizing field of 22½ degrees.

	a	b	c	
Aperture.	6	7	8	mm.
Each.	**$5.75**	**$7.25**	**$12.00**	

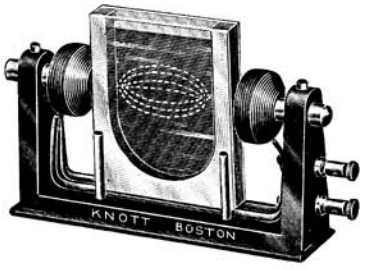
MAGNETISM AND STATIC ELECTRICITY



No. 80–123 No. 80–10 No. 80–150

80–10 **LODESTONE or NATURAL MAGNET** $0.50
80–11 **LARGE LECTURE TABLE LODESTONE or NATURAL MAGNET,** selected quality ..... .90
80–14 **SUPPORTING STIRRUP FOR LODESTONE** used in illustrating action of the earth's magnetic force ..... .65
80–22 **HORSESHOE MAGNET, 3-inch,** with keeper ..... .25
80–24 ——, **4-inch** ..... .55
80–26 ——, **6-inch** ..... .85
80–28 ——, **8-inch** 1.50
80–30 **HORSESHOE MAGNET, 5½-inch,** poles ¾×½ inch, 2 inches between poles 1.25
80–32 **U-SHAPED MAGNET** (see Fuller & Brownlee, Exp. 85) ..... .95
80–35 **COMPOUND HORSESHOE MAGNET, two magnets,** with keeper 2.90
80–37 **EIGHT-INCH COMPOUND HORSESHOE MAGNET, four 8-inch magnets,** with keeper 8.25
80–55 **BAR MAGNET, 2×¼×¼ inch** ..... Each, **$0.20.** Per dozen 2.25
80–57 ——, **6×½×¼ inch** ..... .45
80–59 ——, **8×½×¼ inch** ..... .65
80–70 **BAR MAGNETS IN BOX WITH KEEPERS,** one pair 6-inch bar magnets in box with keepers .. 1.25
80–80 **ROUND BAR MAGNET,** 6 inches long by ⅜-inch diameter ..... .70
80–85 **BREAKING MAGNET** for illustrating that both polarities are present at all parts of the bar and not merely at the ends; 6 inches long by ¼-inch square, weakened at various points to facilitate in the breaking ..... .60
80–87 **GLASS TUBE AND STEEL FILINGS** for illustrating the molecular character of magnetism ..... .45
80–90 **MAGNETIZED STEEL DISC,** diameter 2 inches ..... .55
80–100 **HARDENED STEEL RODS (KNITTING NEEDLES)** ..... Per set of four .20
80–102 **DARNING NEEDLES, large.** ..... Package of 25 needles .25
80–105 **SOFT IRON BAR, 6×½ inch,** best quality soft iron ..... .30
80–106 ——, **20×½ inch** 1.25
80–107 **SOFT IRON HORSESHOE CORE** (see Millikan, Gale & Bishop, Exp. 30) ..... .25
80–108 **CYLINDRICAL IRON ARMATURE** (see National Physics Direction Sheets, Exp. E011) ..... .05
80–109 **TWO-PART IRON ARMATURE** (see National Physics Direction Sheets, Exp. E011) ..... .07
80–110 **NICKEL STRIP, 4×¼ inch,** for showing that other substances than iron have magnetic properties. .30
80–115 **MAGNETIC SCREENS** for illustrating magnetic transparency. A set of six screens, some paramagnetic, others diamagnetic. Per set of six 1.15
80–117 **PARAMAGNETIC AND DIAMAGNETIC SUBSTANCES.** ..... Package .40
80–120 **MAGNET STIRRUP.** A wire stirrup to hold a bar magnet suspended by a string ..... .25
80–123 **BLACK'S MAGNET AND FRICTION ROD SUPPORT.** The carrier is constructed of lightweight metal and is balanced on a hardened steel supporting needle. A magnet or friction rod resting on this carrier reacts readily to other magnetic or static charges 2.65
80–150 **MOLECULAR MAGNET MODEL** for demonstrating the distribution of magnetism in magnetic rods. Each of the 24 small magnets is about 2 cms. long and is mounted on a steel supporting needle. Many interesting and instructive experiments are possible 11.50
80–155 **FLOATING MAGNETS** for illustrating attraction and repulsion of magnetic poles. A set of six small magnets each on a mount that will float in water. Per set ..... .45

No. 80–160



No. 80–225

80–160 **SUPPORTING BOARD** for use with a magnet (bar magnet or Horseshoe Magnet **No. 80–30**) in study of magnetic lines of force. In use a sheet of blueprint paper is pinned to the board over the magnets which set flush in the grooves as illustrated **$1.20**

80–165 **MAGNET SUPPORTS** for use with **No. 80–55** Magnets in study of magnetic lines of force. These supports are strips of wood same thickness of magnets. In use the blueprint paper is pinned to the strips..... Per pair **.10**

80–167 **SPECIAL MAGNET BLOCK** (see National Physics Direction Sheets, Exp. E011)..... **.05**

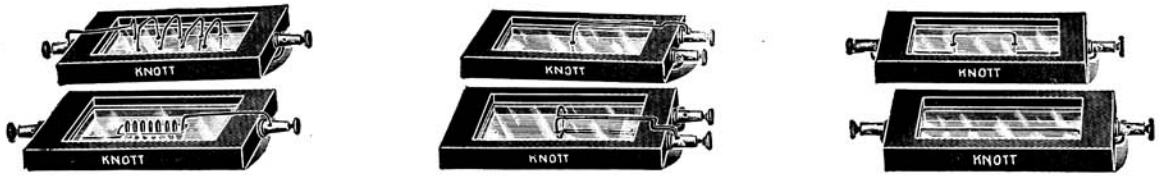
6330c **GLASS PLATE, 6×6 inches,** for use in mapping magnetic fields of force..... **.09**

80–180 **IRON FILINGS,** selected fine, soft, iron filings ..... Per ¼ lb, **$0.10.** Per lb. **.25**

80–185 **FILINGS SIFTER**..... **.25**

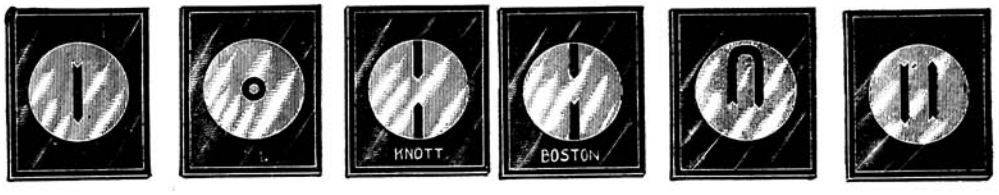
80–187 **CHEESE CLOTH BAG**..... **.15**

80–225 **TOEPLER'S LINES OF FORCE APPARATUS** for showing magnetic field between the poles of an electro-magnet. This design is excellent for projection work. In use the glass trough is filled with glycerine in which iron filings have been mixed. Cast metal base, neatly japanned..... **11.00**



No. 80–230

80–230 **MAGNETIC LINES OF FORCE APPARATUS** recommended for use with a vertical projector in showing on a screen the lines of force about a current bearing conductor. Consists of a set of six plates each in a wooden frame. Set into these glass plates are various wire forms, the ends terminating in binding posts in the frames. Set of six forms..... **18.00**

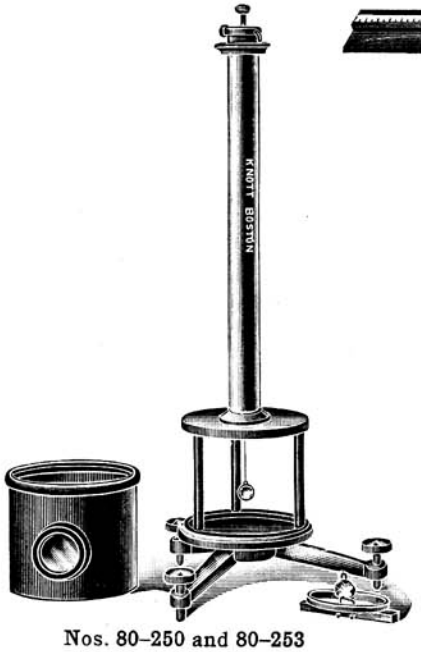


No. 80–232

80–232 **MAGNETIC LINES OF FORCE APPARATUS** recommended for use with a vertical projector in showing on a screen the lines of force about a permanent magnet. Consists of a set of six slides, each slide consisting of two glass plates between which are placed thin steel magnets of various forms and arranged as illustrated. ..... Per set **5.00**

80–235 **MAGNETIC LINES OF FORCE SLIDES** for illustrating on a screen magnetic fields of force as shown by iron filings. Set of five slides: (1) Single Bar magnet; (2) Two Bar Magnets, Unlike Poles; (3) Two Bar Magnets, Like Poles; (4) Two Bar Magnets at Right Angles; (5) Ring Magnets. Per set **2.75**

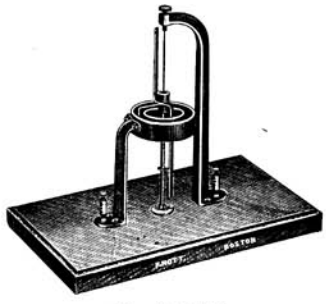
MAGNETOMETERS



Nos. 80–250 and 80–253

No. 80–270

No. 80–280



No. 80–300

80–250 MAGNETOMETER (see Millikan & Mills, Exp. 2) for determination of the ratio M/H. The suspension system consists of five small magnets cemented to the back of an optically plane glass mirror. This system is held by a silk fibre suspended from a graduated torsion head. The brass housing is so mounted on the tripod that it may be turned about a vertical axis. The outer wall of this housing, with clear, flat glass window, may readily be removed as illustrated, without disturbing the suspension system. Magnetometer complete with suspension system..... **$35.00**

80–252 MAGNET HOLDER AND METER ROD SUPPORTS. Consists of a pair of cast brass meter stick supports and a spring brass clamp for holding the magnet of **No. 80–253** at any point on a meter stick. Without meter stick..... **3.75**

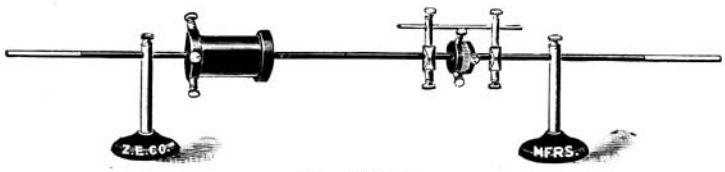
80–253 MAGNETOMETER SYSTEM AND INERTIA RING for use with **No. 80–250** in determining the value of MH. Consists of a stirrup to which is attached a plane mirror and which is designed to hold a special magnet and an inertia ring. Inertia ring, special magnet and stirrup with attached mirror..... **6.75**

80–255 MAGNETOMETER. For the determination of H (the strength of a magnetic field) and M (the magnetic moment) it is necessary to determine the value both of M/H and MH. **Nos. 80–250, 80–252** and **80–253** will all be required. For convenience in ordering, we list these three numbers under the one number. Complete..... **45.50**

80–270 DEFLECTION MAGNETOMETER for comparing the strength of the poles of a bar magnet. The meter rod is mounted on a polished hardwood base and is provided with a recess at the 50 cm. mark for the delicate magnetic needle. Complete as illustrated..... **5.00**

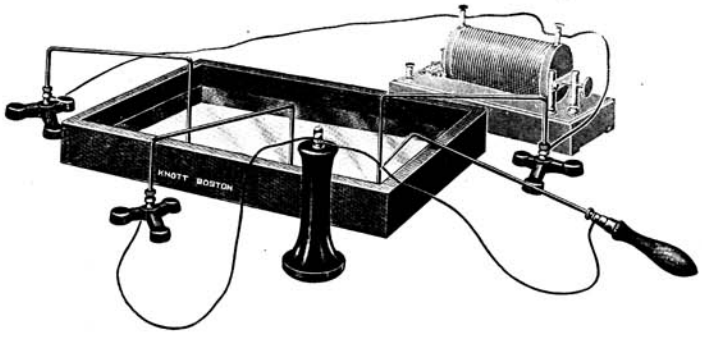
80–280 MAGNETOSCOPE (see Chute's "Physical Laboratory Manual," Prob. 104 to 106). Complete as illustrated..... **2.00**

80–300 MAGNETIC POLE ROTATION APPARATUS for demonstrating the tendency of a current and a magnet pole to rotate about each other. The mercury trough is of cast iron, electrically connected to one cast metal upright. The special magnet fitted with steel mercury cup is supported on a needle point and is electrically connected to the second cast metal upright. A current of 3½ amperes at 7 volts at least will be required to properly demonstrate the experiment..... **13.50**



No. 80–325

No. 80–305



No. 80–350

No. 80–310

80–305 PARALLEL CURRENT APPARATUS for demonstrating mutual actions of parallel currents. Parallel currents flowing in the same direction are secured by connecting both binding posts with one pole of the battery. The other pole should be connected to a binding post (not shown in the illustration) fastened to the base and in electrical connection with the mercury well. Success of the experiment depends upon amalgamating the ends of the copper rods and upon allowing the rods to just make contact with the surface of the mercury **$4.25**

80–310 VIBRATING SPIRAL APPARATUS for illustrating mutual action of parallel currents. When a current is allowed to pass through the spiral, there is an attraction between the convolutions, causing the lower end of the spiral to break the electrical connection with the mercury. The weight of the spiral then causes contact again, which, in turn, sets up attraction of the convolutions. Continual making and breaking contact with the mercury causes this spiral to vibrate up and down **4.25**

80–325 IMPROVED MAGNETIC DISTRIBUTION APPARATUS (see Millikan & Mills, Exp. 12) for studying the distribution of magnetism along a soft iron rod magnetized by induced currents from a magnetizing helix. For magnetizing purposes a test coil which may be clamped to any part of the bar is supplied. A small reel wound with fine wire is employed as the induction coil. The range of play and the position of the test coil are determined by two brass guides between which this reel is placed. The guide and reel are each provided with screws for clamping to the rod. Complete as illustrated **15.50**

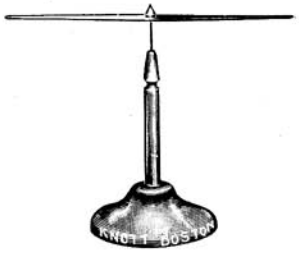
80–350 EQUIPOTENTIAL DETERMINATION APPARATUS (see Millikan & Mills, Exp. 1) for mapping the equipotential surface of an electrical field and drawing the force lines. The apparatus consists of a field tray of a design improved by Mr. C. H. Andrews, principal of the High School of Commerce, Worcester, Mass., so that it is impossible for the salt solution to come in contact with the co-ordinate paper. It is also possible to thoroughly clean the tray without removing the glass plate, and to readily replace a broken glass plate. The potential arms are of brass rod, weighted at one end, and each with binding post. The equipotential seeker is a brass rod with insulating handle and binding post. Without telephone receiver or induction coil, but otherwise complete as illustrated **17.50**

80–355 INDUCTION COIL, small size with modified vibrator, especially adapted for use with above... **7.50**

98–100 BI-POLAR DISSECTIBLE TELEPHONE RECEIVER as illustrated over **No. 80–350** **2.75**

TERRESTRIAL MAGNETISM

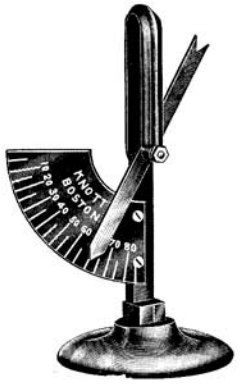
MAGNETIC NEEDLES



No. 81–10

No. 81–15

No. 81–50



No. 81–55

81–10 **MAGNETIC NEEDLE,** 6-inch, brass capped, **agate bearing,** on stand **$1.80**

81–12 ——, **brass capped** only **1.10**

81–15 **ASTATIC NEEDLE,** 6-inch, **brass capped** on stand **2.60**

81–50 **PYLE'S DEMONSTRATION DIP NEEDLE.** In this design the student should magnetize one of the four steel rods supplied with the apparatus and should then balance it as illustrated in the clamp holder provided for the purpose **2.40**

81–55 **DIPPING NEEDLE** for showing magnetic dip. The forked metal upright supports the graduated arc and the bearings for the delicately balanced needle **4.50**

MAGNETIC COMPASSES

No. 81–65

Nos. 81–76 to 81–78

Nos. 81–85 to 81–87

No. 81–95

No. 81–100

81–65 **MINER'S COMPASS or DIPPING NEEDLE,** a serviceable guide to the location of magnetic iron ore. 3½ inches diameter, raised, silvered, graduated dial, brass cap cover, brass ring handle. Held as illustrated, this compass is a dipping needle; horizontally, it serves as a sensitive magnetic compass. In plush-lined box **$15.00**

81–75 **MAGNETIC COMPASS, 12 mm. diameter,** metal cap needle, brass case, card dial. ..... Dozen **2.25**

81–76 ——, **25 mm. diameter,** with ring ..... **.45**

81–77 ——, **35 mm. diameter,** with ring ..... **.65**

81–78 ——, **50 mm. diameter,** with ring ..... **.85**

81–85 **MAGNETIC COMPASS, 30 mm. diameter,** superior quality, raised metal dial with full circle divisions. Metal capped, **agate bearing,** brass case with stop for needle **2.10**

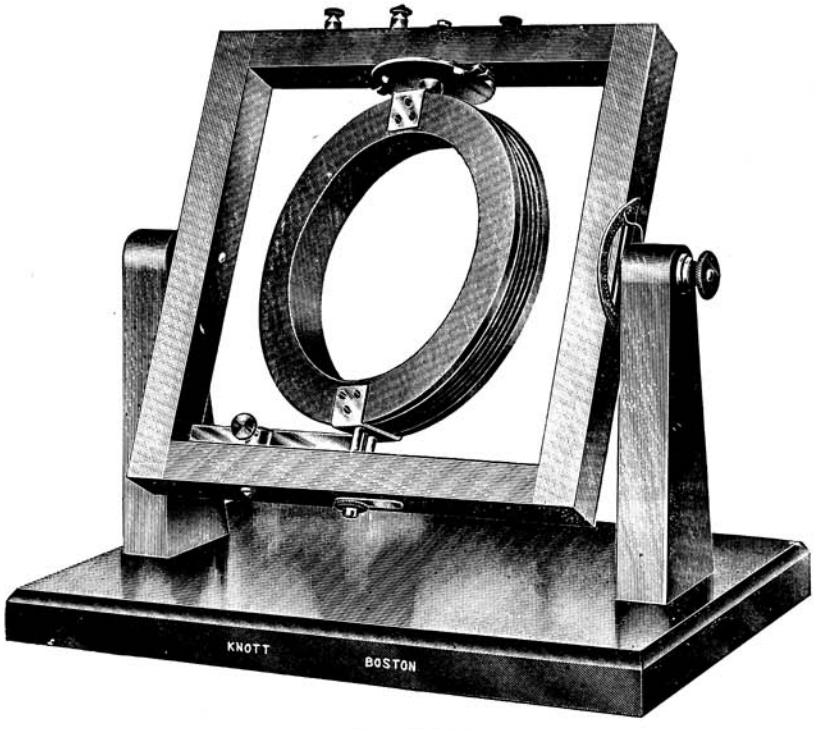
81–87 ——, **50 mm. diameter** **2.40**

81–95 **MAGNETIC COMPASS, 50 mm. diameter, 37 mm. aluminum pointer,** raised metal dial with full circle divisions. Metal capped, **agate bearing,** brass case with stop for needle **2.75**

81–100 **MAGNETIC POCKET COMPASS, 2½ inches diameter,** brass capped, card dial with full circle divisions, brass case with stop for needle. In hinged cover mahogany box **2.50**

81–101 ——, silvered metal dial, raised ring, brass capped **agate bearing** **4.50**

UNIVERSAL INCLINATION EARTH INDUCTOR



No. 81–155

81–155 UNIVERSAL INCLINATION EARTH INDUCTOR for exact study of the magnetic moment of the earth's pole. This improved design consists of a substantial base with uprights to which is swiveled a frame carrying a ring. The frame carrying the coil may be inclined to any angle within 180 degrees, the inclination being indicated by a pointer moving before a graduated arc. The ring has a groove in which are coiled about 1,000 turns double silk-covered wire. The leads of this wire are heavily insulated and the ends brought to binding posts shown on top of the frame. A positive throw is secured by a simple spring device shown at the bottom of the frame. This device, when set for use, is held by a projecting rod acting against the spring giving to it a tension. A release and stopping device, actuated by one button, gives to the ring a definite rotation through 180 degrees. This inductor is carefully made and must not be confused with those of lower price on the market. Our mounting is of the most substantial construction, well finished, making the instrument not only of scientific value, but one in which any laboratory will take pride.

Features:

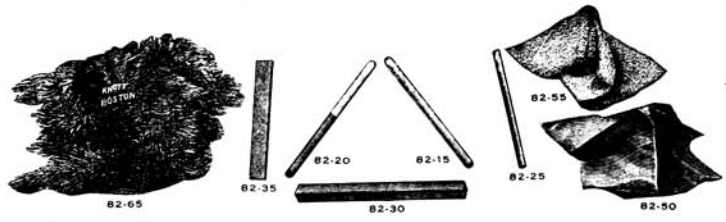
1. Universal inclination in two planes.
2. Gimbal mounting for varying the angle of inclination.
3. Graduated arc and pointer for easily determining the same.
4. Positive spring device for securing a definite rotation through 180 degrees.
5. A release and stopping device actuated by one button.

To facilitate in determining the constant of the instrument, the B. & S. Gauge number of wire, the inner and outer diameter of the coil, the number of turns in the coil and the resistance are all permanently recorded on the instrument.

PRICE, $57.50

GENERATION OF STATIC ELECTRICITY

FRICTIONAL ELECTRICITY ACCESSORIES



82–10 **AMBER SPECIMEN** **$1.75**

82–15 **GLASS FRICTION ROD,** 12×½ inches. Develops a positive charge when rubbed with silk, negative when rubbed with catskin or flannel ..... **.20**

82–20 **GLASS FRICTION ROD, half length ground, half polished surface.** Develops both positive and negative charges, regardless of the rubber ..... **.45**

82–25 **VULCANITE FRICTION ROD.** Develops a negative charge ..... **.50**

82–30 **WAX FRICTION ROD.** Develops a negative charge ..... **.30**

82–35 **CELLULOID STRIP, 12 inches long.** Develops a negative charge ..... **.20**

82–40 **FRICTION ROD, HALF GLASS, HALF BRASS,** for showing rapid conduction of a charge from a conductor **1.75**

82–50 **SILK EXCITING PAD** ..... **.75**

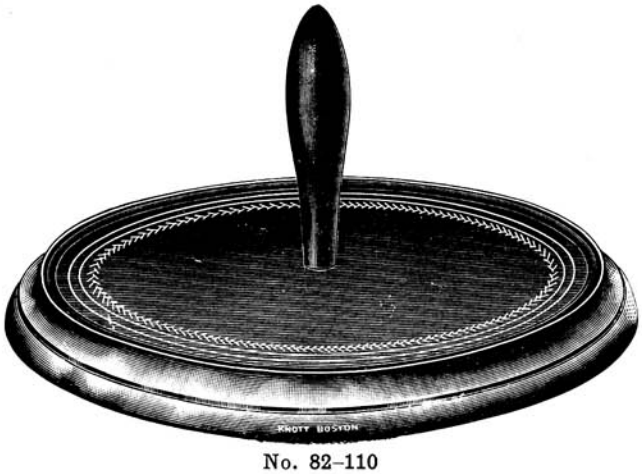
82–55 **FLANNEL EXCITING PAD** ..... **.60**

82–57 **FLANNEL CAP WITH ATTACHED SILK CORD** (see Millikan & Gale, Fig. 228) ..... **.30**

82–60 **CATSKIN, whole skin,** small cat or kitten **1.65**

82–65 **CATSKIN, whole skin,** large cat **2.40**

82–77 **THE IMPROVED POTENTIAL BAR.** This bar is designed to maintain a constant potential difference of 1000 volts, mounted in form for convenient and satisfactory use with electroscopes, electrometers, Leyden jars and other high potential electrical instruments. This is undoubtedly the most valuable single instrument obtainable for the study of electrostatic phenomena. Enables the instructor to carry on satisfactory lecture table demonstrations in static electricity regardless of atmospheric conditions **15.50**



No. 82–110

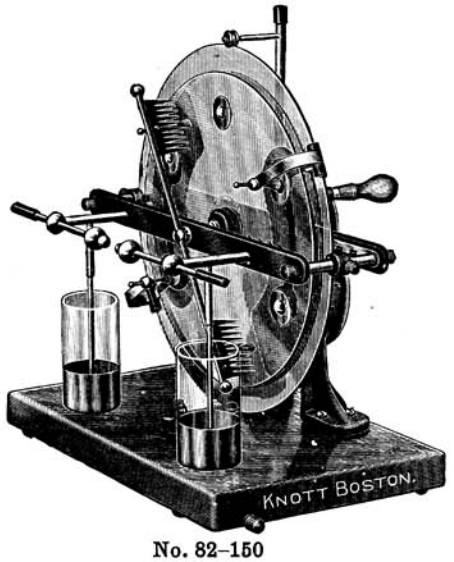
No. 82–115

82–110 **RITCHIE LECTURE TABLE ELECTROPHORUS, 13½ inches diameter,** for generation of static charges by induction. A hard rubber plate about 12 inches in diameter is firmly attached to a polished and lacquered metal base. The disc, 10 inches in diameter, is greatly improved in design over disc shown in illustration so that a charge can be retained for hours **11.75**

82–115 **CAST BASE ELECTROPHORUS.** A resinous compound is moulded into a **shallow trough casting.** The disc is of heavy brass, provided with an insulating handle **5.00**

GEAR-DRIVE INFLUENCE MACHINES

TOEPLER-HOLTZ — WIMSHURST



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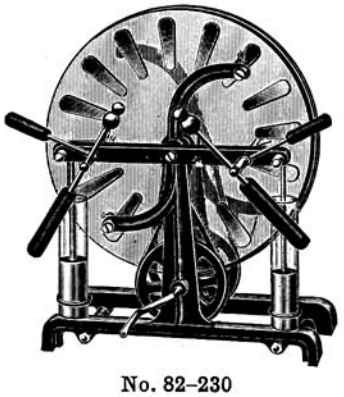


No. 82–230

It is a fact generally recognized by all manufacturers of these machines that the simpler the machine, the better it is electrically, providing, of course, that the mechanism will hold the various parts in their proper positions during operation. The greatest drawback to obtaining this result has been the "belt drive" with its recognized defects in slipping, breaking, slipping off the pulley, etc., but which has been universally used because of its low cost of manufacture. In correcting this defect and to enable us to improve our product, as well as increase the efficiency electrically, we have selected the **self-contained gear drive** in which accurately cut gears operate in a case filled with heavy oil — a form of construction which automobile manufacturers have brought to a high state of perfection. With this mechanism the power is applied at the same rigid support which holds the main axis of the machine. There is, therefore, no tendency to change the relation of the brushes, collectors and plates, as all are mounted on this same central shaft.

FEATURES — DETAILS OF CONSTRUCTION

1. **Glass plates** of a selected quality of toughened glass, chemically treated and coated with a special varnish which gives to the plates a durable, hard and smooth surface.
2. **Collector combs** are particularly efficient in collecting the plate charge with little loss. They are unusually long and sharp and, since centrally mounted, it is impossible for them to scrape against collector buttons.
3. **Collecting brushes** will be found a decided innovation. The **brush holder** is of the spring-clamp type, giving a positive contact and can be attached in an instant. Brushes are readily adjusted in these holders.
4. **Positive gear drive** — accurately cut gears operate in heavy oil within the oil-tight gear casing.
5. **Insulation, condensers** and other details of construction have been most carefully considered and all details combine to enable the demonstrator to secure a machine particularly well adapted to the most exacting requirements.

We wish once more to call to attention the unit method of mounting, by which all of the essential parts of the machine, together with the motive power, are attached directly to the rigidly constructed central support.

82–150 KNOTT'S GEAR-DRIVE TOEPLER-HOLTZ MACHINE, revolving plate 12 inches, stationary plate 14 inches in diameter; spark discharge 3 to 4 inches, depending upon weather conditions... **$40.00**

Repair Parts

82–151	**REVOLVING PLATE,** 12 inches diameter, complete	Each	**3.25**
82–152	**STATIONARY PLATE,** 14 inches diameter, complete	Each	**4.25**
82–153	**LEYDEN JAR**	Each	**1.25**

82–230 KNOTT'S GEAR-DRIVE WIMSHURST MACHINE, two 8-inch counter-revolving plates; spark discharge 2 to 3 inches, depending upon weather conditions... **16.50**

Repair Parts

82–231	**REVOLVING PLATE,** 8 inches diameter, complete	Each	**1.50**
82–232	**LEYDEN JAR**	Each	**.50**

83–10 **PITH BALLS,** assorted plain and colored ..... Per dozen **$0.45**

83–12 **PITH BALL STATIC ELECTROMETER,** attached to silk cord, ready for use ..... Each **.20**

83–15 **METALLIC COATED PITH BALL,** vastly more sensitive than the uncoated ..... Each **.15**

83–18 **PITH BALL,** 20 mm. diameter, metallic coated ..... Each **.50**

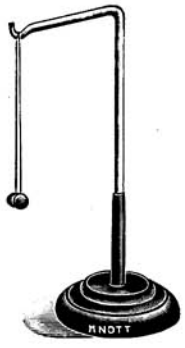
83–33 **GOLD-LEAF, PURE GOLD,** in book form for electroscope ..... Per book **1.40**

83–35 **ALUMINUM-LEAF,** in neat, compact roll, especially prepared for electroscope work ..... Per roll **.60**

83–40 **TIN FOIL** for Leyden Jar coatings, condensers, etc. ..... Per lb. **.75**

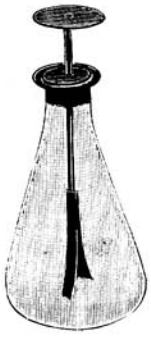
No. 83–50

83–50 **GILDER'S KNIFE, PAD AND TIP** for cutting gold-leaf. Frequent statements have been made us that it is almost impossible to replace broken leaf on electroscopes. This trouble arises, principally, from lack of proper tools. The outfit illustrated above will facilitate in the cutting and handling of even the finest gold-leaf. Knife, pad and tip, complete **3.50**

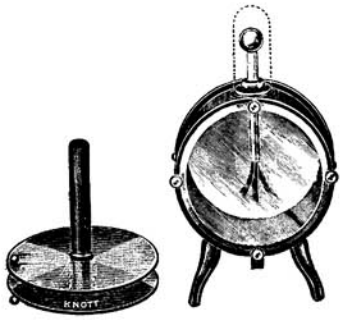


No. 83–75

No. 83–105



No. 83–135



No. 83–142

83–75 **PITH BALL ELECTROSCOPE** for qualitative demonstration of static charges. This apparatus consists of a base on which is mounted an insulated support with arm. To this arm are suspended two pith balls, by fine silk fiber **1.60**

83–101 **PITH BALL ELECTROSCOPE,** large size for lecture table demonstration. Two pith balls, 20 mm. diameter, mounted as illustrated in **No. 83–75** **2.50**

83–105 **CHRISTIAN BROTHERS' ELECTROSCOPE.** The needle is provided with brass cap and is mounted as illustrated on an insulating stand. This electroscope is extremely sensitive and indications are positive! **1.50**

83–135 **STUDENTS' ELECTROSCOPE,** simple flask form **1.25**

83–136 **——, with sulphur insulation** which by actual hard-service tests has been found superior to amber ... **2.25**

83–142 **CAST DRUM GOLD-LEAF PROJECTION ELECTROSCOPE with sulphur insulation** which by actual hard-service tests has been found superior to amber. Housing and legs are cast metal, windows front and back are dust-proof, but easily removable. A spun-metal cup, shown in dotted lines, is provided to obstruct radio-active influences. The ball top is removable when it is desired to use the condenser plate attachment for demonstrating that the plates of a galvanic cell are statically charged. Complete with plates as illustrated **15.90**

83–143 ——, without condenser plate attachment but with spun-metal cup **11.50**

83–144 **CONDENSER PLATE ATTACHMENT** for use with **No. 83–143** in demonstrating that the plates of a galvanic cell are statically charged. These are heavy brass plates, one provided with a rod to replace the ball top, the other provided with an insulating handle **4.40**

83–147 **FECHNER'S ELECTROMETER,** similar to **No. 83–143,** but with the metal leaves adjusted between two highly-polished metal plates. With constant voltage charging box **21.00**

No. 83–165

No. 83–171

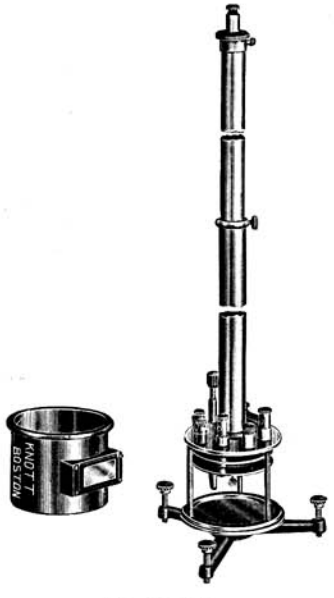
83–165 THE WILSON RADIO-ELECTROSCOPE for research work in radio-activity. This instrument is designed for telescope reading or lantern projection. Every care has been exercised in making as nearly perfect an insulation as possible. An important feature is the method of supporting the gold leaf member. No care is required for leveling, the gimbal bearing support making it perfectly automatic. The opening in the base pillar is provided for the introduction of the substance to be tested. The substance is placed in a watch crystal which can be raised to any desired height by means of the discs seen in the illustration. These discs fix definitely the distance of the radio active substance from the gold leaf. This electroscope has for years been considered the standard for high grade work..... **$22.50**

83–171 TELESCOPE FOR RADIO-ACTIVE WORK for measuring the angular drop of gold leaf in electroscopes or electrometers due to gradual loss of potential under the influence of a radio-active material. The graduated dial is mounted on the eye-piece of the telescope in such a manner that the dial, eye-piece and cross-hair move as one unit. An angular movement of the cross-hair may then be read by the dial and pointer. Without mounting of any kind..... **15.50**

N. B. In use the Telescope **No. 83–171** should be appropriately mounted. We suggest the following:

5–120	**Tripod with Leveling Screws:**	**$2.76**
5–15c	**Support Rod, 60 cm. × 13 mm.**	**1.00**
5–725	**Right Angle Clamp**	**1.25**
5–920	**Telescope Clamp**	**7.25**

83–220 THE RAYBOURN QUADRANT ELECTROMETER with Telescoping Suspension Tube. Where an electrometer of superior sensitiveness and quality is required, this instrument will meet every need.



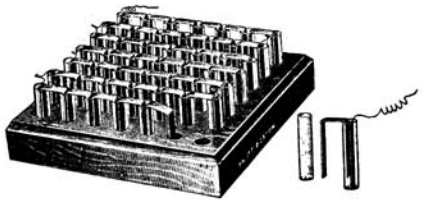
No. 83–220

DISTINCTIVE FEATURES

1. A quadrant box of open construction affording easy access and view of the needle.
2. A needle of very light weight, aluminum welded to the axis wire of copper, the upper end of which is bent to form a hook for attaching suspensions. This construction greatly lessens the surface resistance of the metal, which, in case of an aluminum hook ordinarily used, is very great.
3. A space beneath the quadrants is ample for placing drying material.
4. A very light-weight optically-plane mirror.
5. Pure amber insulation throughout.
6. A zero adjustment, simple but most effective and impossible of accidental derangement.
7. A removable metal protecting case with large rectangular opening covered by a window of uniformly thin flat glass.
8. Mounted on tripod and held to same by a friction clamp which permits of a rotary movement of the electrometer.
9. Binding posts and links permit grounding of case or either pair of quadrants.
10. Suspensions may be readily attached.
11. A telescoping support allows suspensions of any desired lengths within range of from 30 to 50 cms.
12. Inasmuch as degree of sensibility required depends upon the nature of the work, we supply our stock instruments with a metallic suspension 50 cms. long. These suspensions will be found very durable and sufficiently sensitive for all work except where extreme sensibility is required, in which case we are prepared to furnish other types of suspensions.

As carried in stock, this electrometer is supplied with a 50-centimeter phosphor-bronze suspension ribbon which, while it is extremely durable, will give ample sensibility for most purposes.. **65.00**

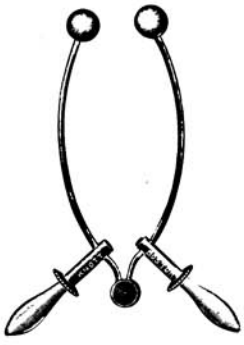
83–222 CONSTANT VOLTAGE CHARGING BOX for easy and convenient charging of electroscopes and electrometers. Maintains a constant difference of electrical potential of 250 volts..... **6.50**



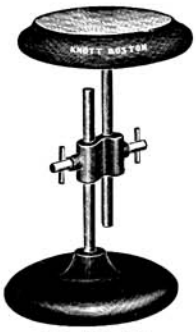
No. 83–250

No. 84–40

No. 84–25



No. 84–30

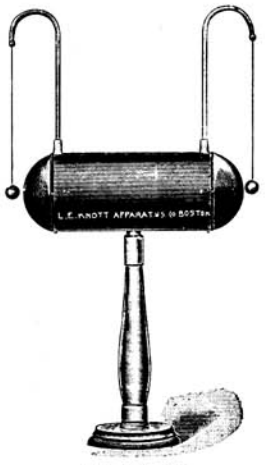


No. 84–15

No. 84–50

No. 84–70

No. 84–20



No. 84–60

83–250 **WATER BATTERY, 50 cell,** for charging needles of electrometers and for charging electroscopes. Extremely useful when high voltage and low amperage are desired, giving real, constant and well-defined electromotive forces. Mounted as illustrated on neatly-finished wooden base..... **$19.75**

83–252 **——, 100 cell,** a combination of two of **No. 83–250** batteries..... **39.50**

83–275 **RADIO-ACTIVE SUBSTANCES.** A set of four radio-active substances, black uranium oxide, pitch blende, thorium nitrate, and uranium metal, each in sealed glass-stoppered bottle .....Set of four **4.50**

84–10 **LARGE INSULATING STOOL** for insuring total insulation from the earth. A substantial, finely-finished wood base, provided with four glazed porcelain legs, the insulating qualities of which are unexcelled..... **4.25**

84–15 **ADJUSTABLE INSULATING STAND.** Consists, as illustrated, of a supporting insulating plate held adjustably by two vulcanite rods to a metal base..... **5.50**

84–20 **PROOF PLANE,** simple disc type with insulating handle..... **.45**

84–25 **GUARDED DISCHARGER,** polished brass arc with ball terminals, ebonite handle with disc guard. **1.50**

84–30 **TWO-HANDLED JOINTED DISCHARGER,** two polished brass arcs with ball terminals. Jointed, with ebonite handle..... **4.25**

84–40 **SHOCKING HANDLES.** Two nickel-plated metal handles, one with insulated carrier, two conducting cords, each cord with connecting tip.....Per pair **1.95**

84–50 **INDUCTION AND DISTRIBUTION SPHERE, 6 inches diameter,** for demonstrating that a charge remains on the outer surface and does not penetrate into the interior. A highly polished hollow spun brass sphere with opening in the top, and mounted as illustrated on an insulating stand. **9.00**

84–55 **——, 4½ inches diameter**..... **5.50**

84–57 **INDUCTION SPHERES, 2 inches diameter.** A pair of nickel-plated hollow brass spheres, each mounted on insulating support, so that they can be brought in contact.....Per pair **7.50**

84–60 **INDUCTION CYLINDER, 16-inch,** for illustrating electrostatic induction. A polished hollow brass cylinder, 16 inches long, mounted on an insulating support and provided with movable brass arms to which pith balls are attached..... **17.50**

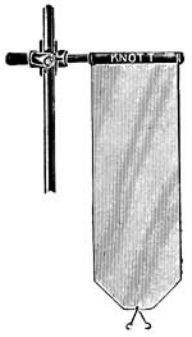
84–65 **——, 8 inches long**..... **7.75**

84–70 **HOLLOW INDUCTION CYLINDER** for demonstrating that a charge collects on the surface. Consists of a polished brass tube with pith balls mounted within and without as illustrated. On insulating support..... **4.25**

No. 84–75

No. 84–80

No. 84–86



No. 84–90

No. 84–100

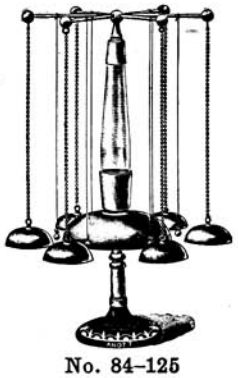
84–75 **FARADAY'S METAL SHIELD or ELECTRIC SCREEN, 9×5½ inches,** for protecting electroscopes from external electric fields to illustrate the principle of protection from lightning, also the Marconi system of selecting electric signal waves **$1.50**

84–80 **ELLIPSOIDAL CONDUCTOR, 8½×3½ inches,** for demonstrating the tendency of static distribution. Consists of a polished hollow brass ellipsoidal body mounted as illustrated on an insulating support **7.50**

84–85 **BIOT'S HEMISPHERES** for demonstrating that a static charge seeks the outer surface of a body. Two polished brass hemispheres each with insulating handle. These hemispheres are designed to fit **No. 84–55** Induction and Distribution Sphere **6.50**

84–86 **INDUCTION AND DISTRIBUTION SPHERE AND BIOT'S HEMISPHERES Nos. 84–55** and **84–86** complete as illustrated **12.00**

84–90 **RITCHIE'S SURFACE AND INTENSITY APPARATUS** for showing the variation of electrical density on a unit of surface as that surface is diminished or increased. Consists of a vulcanite rod to which is attached a metallic coated screen operating on a spring roller. A pith ball electrometer in metallic contact with the metallic coating indicates the quantity of electrical force. In use this apparatus may be held in the hand or mounted as suggested by the illustration. Without supporting stand **5.75**



No. 84–125

84–100 **FARADAY'S CONICAL NET, 11×5 inches,** for demonstrating that an electrical charge seeks the outer surface of a body. Consists of a conical bag of linen gauze supported on an insulating stand and to which are attached silk cords by which the bag may be turned inside out **2.75**

84–125 **LARGE DEMONSTRATION BELL CHIMES** for demonstrating electrostatic attraction and repulsion between electrified bodies. The six small bells are adjusted on chains so that all six will be in the same plane as the large bell. The six small metal balls are adjusted on silk cords so that they are all in the same plane as the bells. Cross head support is insulated from large bell which in turn is on an insulating support. When electrified the small balls will be attracted and repelled between the large bell and the small bells, causing a continuous jingle **25.00**

84–130 **UNMOUNTED BELL CHIMES,** ordinary type **1.75**

84–155 **IMAGE PLATES** for illustrating electrostatic attraction or repulsion. Two nickel-plated metal discs suspended one to the other by insulating cords. With metal hook and chain as illustrated. Without pith images **3.75**

84–157 **PITH IMAGES** for use with **No. 84–155** ..... Per pair **1.00**

84–175 **POLE TEST PAPER.** When two electrical leads are placed close together upon a moistened strip of this paper, the negative pole is distinguished by the pinkish stain which it causes ..... **.10**

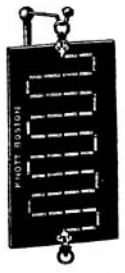
No. 84–155

No. 84–200

No. 84–202

No. 84–208

No. 84–210


No. 84–212

No. 84–214

84–200 **UNIVERSAL STAND,** designed to support **Nos. 84–202, 84–208, 84–210, 84–212** and **84–214**..... **$1.90**

84–202 **ELECTRIC PLUME OR BRUSH.** When charged, paper strips will repel each other and stand out as illustrated..... **1.50**

84–208 **ELECTRIC WHIRL OR FLIER.** When connected to static machine, charge will flow from the points, causing rotary motion..... **1.25**

84–210 **HOLDER FOR GEISSLER TUBE OR LIGHTNING PLATE**..... **.75**

84–212 **EBONITE LIGHTNING PLATE.** Spectacular sparks across gaps in tin foil when connected with static machine..... **2.50**

84–214 **LIGHTNING SPIRAL TUBE.** Spectacular spiral of sparks across gaps in tin foil when connected with static machine..... **2.75**

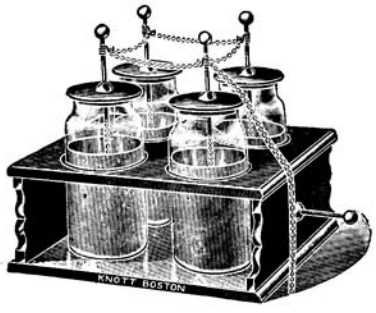
84–226 **CONDUCTOR CHAINS** for connecting accessories to static machine..... **.50**

No. 85–10

No. 85–15

No. 85–20

No. 85–40


No. 85–65

85–10 **DEMONSTRATION LEYDEN JAR** for demonstrating that an electrical charge resides as potential energy in the glass of a leyden jar and not in the metallic coatings. The inner and outer metallic coatings are removable, the inner provided with rod with ball terminals..... **5.50**

85–15 **QUART LEYDEN JAR** for storing static electricity..... **3.50**

85–20 **TWO-QUART LEYDEN JAR** for storing static electricity..... **4.25**

85–40 **LUMINOUS LEYDEN JAR** for demonstrating the distribution of static electricity over the surface of a condenser successively charged and discharged.... **6.50**

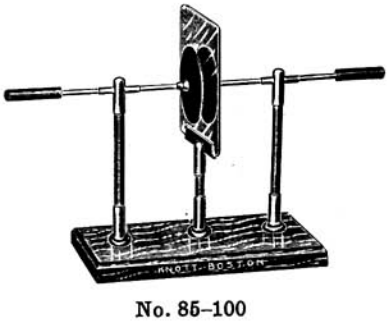
85–60 **LEYDEN JAR BATTERY, two-jar,** for storing static electricity. Box lined with heavy tin foil..... **12.00**

85–65 **——, four-jar**..... **20.00**

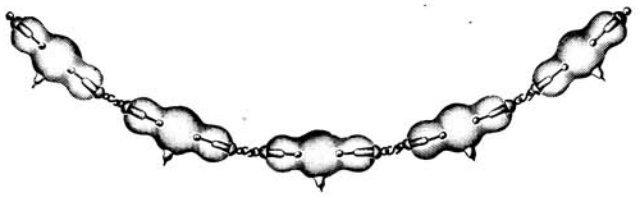
85–70 **——, six-jar**..... **28.50**

85–100 **DISSECTIBLE DEMONSTRATION PLATE CONDENSER** for study of induction in a condenser. The central upright carries a glass plate; each of the other uprights supports a sliding rod at one end of which is a brass disc, at the other an insulating handle. The base is neatly finished hardwood.... **21.00**

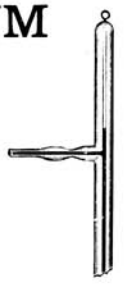
85–105 **MOUNTED CONDENSER PLATES.** (See Millikan, Gale and Bishop, Exp. 27).....Per pair **.55**


No. 85–100

GEISSLER — SPECTRUM — VACUUM TUBES



No. 86-75



No. 86-85

86–11 **GEISSLER TUBES, 6 inch,** uranium and white glass, various shapes ..... Each **$1.25**

86–12 **——, 8-inch** ..... Each **1.50**

86–42 **LECTURE TABLE GEISSLER TUBES, 10-inch.** A set of six tubes selected to show fluorescence of liquids, phosphorescence, colors through different qualities of glass and different gases, and change of color in a mercury salt. In cardboard box **13.75**

86–75 **UNEQUALLY EVACUATED GEISSLER TUBES.** A set of five tubes which may be connected as illustrated. Each tube is constructed from the same quality of glass but all are unequally exhausted. As a spark passes through the chain, it is well defined in the least exhausted tube but as the vacuum increases, this spark begins to widen out and fill the whole tube, becoming pale in tint and nebulous in form. Per set of five **11.25**

86–85 **EXPERIMENTAL BAROMETER, VACUUM, AND GEISSLER TUBE.** This is the best possible instrument for teaching as a lecture table proposition the working of the Cooper-Hewitt Lamp, the Geissler Tube, Crooke's Tube, X-Ray Tube, and also to show an electrical method of determining the degree of a vacuum, such as the vacuum in the top of the barometer, etc. A most valuable and easily operated lecture table device. The tube is approximately 36 inches long, with a bulb at the bottom sufficiently large to hold mercury enough to fill the entire upper portion of the tube, the air being exhausted from the upper tubulature, the mercury poured in at the lower tubulature. Two platinum wires are provided, one at the top and one at the bottom, for connecting to high tension current. Any small static machine or induction coil which will operate a small Geissler tube is adequate for producing proper results **4.50**

No. 86-150

Nos. 77-225 to 77-236

No. 77-245

77–225 **GEISSLER SPECTRUM TUBE, filled with carbon dioxide** — most careful construction **3.00**

77–226 **——, filled with hydrogen gas** **3.00**

77–227 **——, filled with nitrogen gas** **3.00**

77–228 **——, filled with oxygen gas** **3.00**

77–235 **GEISSLER SPECTRUM TUBE,** most carefully constructed, evacuated, and **filled with pure argon gas** **4.50**

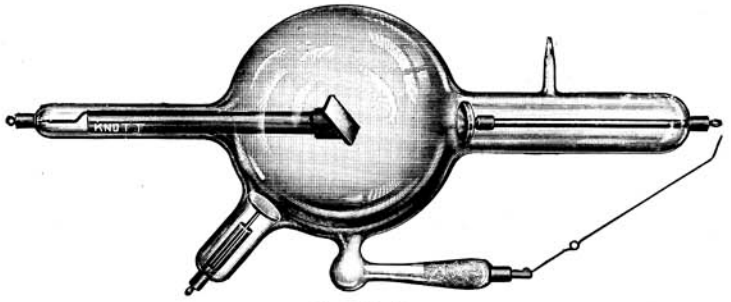
77–236 **——,** same as above, but **filled with helium** **4.50**

77–245 **GEISSLER SPECTRUM TUBE** for evacuating and filling with whatever gas desired. Fitted with two carefully ground glass cocks **5.25**

86–110 **GEISSLER TUBE HOLDER** for use with our **No. 21–10** or **No. 21–30** Rotator to hold Geissler or spectrum tubes for rotation. This holder is adjustable to hold sizes up to 12 inches long **4.50**

86–150 **DE LA RIVES APPARATUS** for demonstrating that magnets act on light in Geissler or vacuum tubes in accordance with the laws with which they act over any other movable conductor. The apparatus consists of a highly evacuated bulb sealed into the lower end of which, and extending up into the the bulb, is a tube, into which extends a rod of soft iron. This rod, in use, is magnetized by an electro-magnet. Terminals of the bulb are connected to an electrostatic current or current from an induction coil, and a beam of light passes from one terminal to the other. When the voltaic current is turned through the electro-magnet, this beam of light turns slowly about the magnetized rod, sometimes in one direction, sometimes in the other, according to the direction of the induced current or of the induced magnetism. Complete with electro-magnet **9.50**

ROENTGEN RAY APPARATUS



No. 87–10

87–10 **AUTOMATICALLY ADJUSTED X-RAY TUBE** for use with small static machines and spark coils operated by battery current. Diameter, 4 inches; with platinum target and with special attachment for maintaining automatically the proper vacuum for most efficient results..... **$15.50**

87–65 **AUTOMATICALLY ADJUSTED X-RAY TUBE** for use with Tesla and high frequency coils. Diameter, 6 inches; with especially constructed platinum anode and with attachment for maintaining automatically the proper vacuum for most efficient results..... **35.00**

No. 87–128

87–100 **SMALL X-RAY STAND,** universal adjustment..... **8.75**

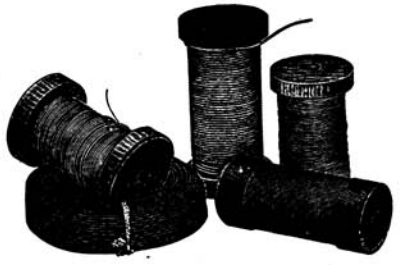
87–128 **HAND FLUOROSCOPE,** 5×7 inches, improved screen..... **25.00**

Suggestive Lists for X-Ray Demonstration

In view of our long association with practical X-Ray work, we are in a position to make up suggestions for an equipment suitable for demonstrating the principle and modern practice of X-Ray work.

ELECTRICITY

ELECTRICAL SUPPLIES



90–10 COPPER WIRE, bare.

	a	b	c	d	e	f	g	h	i
B. & S. Gauge	16	18	20	22	24	26	27	28	30
Price per 1-oz. spool									$0.20
Price per 4-oz. spool			$0.35	.40	.42	.45	.48	.50	.50
Price per 1-lb. spool	$0.90	.95	1.00	1.10	1.15	1.20	1.25	1.35	

90–15 COPPER ANNUNCIATOR WIRE, double cotton-covered, parafinned, B. & S. Gauge **No. 18.** Per ½-lb. coil, **$0.65.** Per lb. coil **$1.25**

90–20 COPPER WIRE, double cotton-covered.

	a	b	c	d	e	f	g	h	i	j
B. & S. Gauge	16	18	20	22	24	26	27	28	30	36
Price per 4-oz. spool			$0.50	.65	.75	.85	.95	1.00	1.25	2.25
Price per 1-lb. spool	$1.20	1.40	1.60	2.25	2.40	2.50	2.70	2.90		

90–35 LAMP CORD, two conductors twisted, B. & S. Gauge **No. 18,** rubber and cotton insulation. Per yard **.25**

90–45 SPRING BRASS WIRE.

	a	b	c	d	e
B. & S. Gauge	22	24	27	28	30
Price per 4-oz. spool	$0.55	.60	.65	.70	.75

90–50 FUSE WIRE.

	a	b	c	d	e	f	g
Amperes	½	1	3	5	10	15	35
Price per yard	$0.07	.08	.10	.12	.18	.25	.40

90–55 GERMAN SILVER WIRE, 18 per cent alloy, bare.

	a	b	c
B. & S. Gauge	26	28	30
Price per 4-oz. spool	$0.95	1.00	1.20

90–60 GERMAN SILVER WIRE, 18 per cent alloy, single cotton covered.

	a	b	bb	c	d	dd
B. & S. Gauge	18	20	24	28	30	36
Price per 4-oz. spool		$1.00	1.25	1.50	1.75	3.00
Price per 1-lb. spool	$2.25					

90–70 IRON WIRE, soft drawn, bare.

	a	b	c	d
B. & S. Gauge	24	27	28	30
Price per 4-oz. spool	$0.30	.35	.40	.45

90–75 IRON PICTURE WIRE, No. 1. Per package **.10**

90–80 LEAD WIRE, ⅛-inch diameter. Per foot **.06**

57–10 PIANO WIRE in ¼-lb. coils, best quality.

	a	b	c	d
Music Gauge No.	12	9	7	5
Approximate diameter, in.	.028	.022	.0178	.014
Per coil	$0.65	.75	.95	1.15

57–12 PIANO WIRE, on spools.

	a	b	c	d
Music Gauge No.	12	9	7	5
Approximate diameter, in.	.028	.022	.0178	.014
Approximate feet on spool	6	8	8	10
Per spool	$0.10	.12	.13	.15

90–100 PLATINUM WIRE.

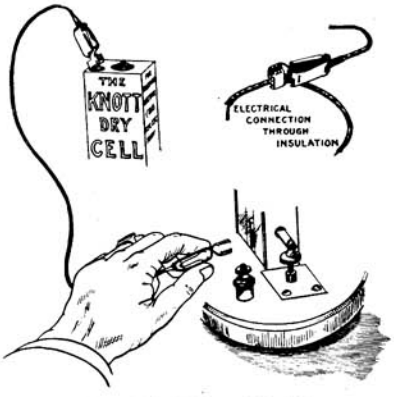
	a	b	c	d	e	f
B. & S. Gauge	20	22	24	26	28	30

In view of the continual market fluctuations in the price of platinum, we quote only on application.

90–105 ZINC WIRE, ⅛ inch diameter. Per foot **.20**

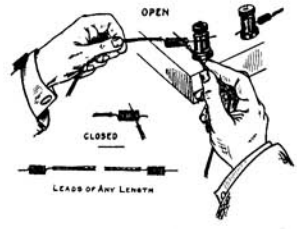
90–150 ARTIFICIAL LIGHT CIRCUIT for reproducing, within the laboratory, conditions similar to those of an actual incandescent lighting circuit as worked out in the Applied Electrical Laboratory of Pratt Institute. A wire of known high resistance per mil-foot, resembling in appearance an ordinary incandescent lighting wire, but having an asbestos insulation to avoid danger of fire. In use this wire is strung along the side of a room or mounted on a movable frame using standard porcelain insulators and cleats, lamp sockets and switches. Fifty-foot Artificial Lighting Circuit complete with special resistance wire, sufficient insulators, cleats, lamp sockets and switch, with full directions and diagrams for setting up **$15.00**

No. 90–175
(Full size)



Nos. 90–185 to 90–187

No. 90–190



No. 90–175
(Various uses)

No. 90–195

90–175 IMPROVED RAPID CONNECTOR TIPS for soldering to wire to form connectors. The spirals can readily be separated by a slight pull and the straight end of another tip slipped in the opening to secure a positive electrical connection. Obviates a multiplicity of connectors, since they can be used with any binding post and are equally well suited for parallel or multiple connections. The spiral is made from phosphor-bronze wire of a size and proportion to give rigidity, yet at same time to enable one to make a positive electrical connection more simply and quickly than with other connectors. ..... Per dozen, **$0.50.** Per hundred **4.00**

90–177 IMPROVED RAPID CONNECTOR, 6-inch. Flexible lead 6 inches long, with Tip **No. 90–175** soldered at each end ..... Each **.15**

90–179 ——, 2-feet, flexible lead 2 feet long, with Tip **No. 90–175** soldered at each end ..... Each **.20**

90–180 ——, 3-feet, flexible lead 3 feet long with Tip **No. 90–175** soldered at each end ..... Each **.30**

90–185 "PRIMO" POSITIVE CONTACT LECTURE TABLE CLASP for soldering to wire to form a connector. Connections to all styles of binding posts, both bare and insulated wire, can easily be made. The grip has teeth which will pierce insulation of even heavily insulated wires and make positive electrical contact ..... Each **.25**

90–187 "PRIMO" POSITIVE CONTACT LECTURE TABLE CONNECTOR, 4-foot. Flexible lead 4 feet long, with Clasp **No. 90–185** soldered at each end ..... Each **.80**

90–190 UNIVERSAL CONNECTOR TIP for use in connecting to either English or American binding posts. The bared end of the lead is placed in the groove and pressed firmly in place by a pair of pliers, then soldered ..... **.05**

90–195 CADY'S HIGH POTENTIAL INSULATED PINCH CONNECTOR designed for high potential currents to insure safety to the worker and to guard against short circuit. Will connect to corners of plates, and assures positive contact with any size of wire, from 5/32-inch diameter to the finest wires or thinnest ribbons. By pressing one of the insulated knobs as shown in the illustration, the spring jaw is opened and the wire inserted. When pressure is released the wire is held firmly in electrical contact. The connector is completely insulated, obviating any possibility of a short circuit or a ground through the operator **2.25**

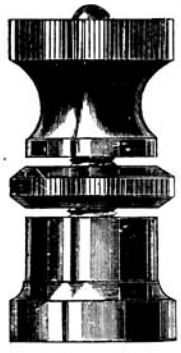
90–220 PORCELAIN INSULATING TUBE (see Fuller & Brownlee, Exp. 74) ..... **.15**

90–221 WOODEN CORE with ATTACHED BINDING POSTS for use with above ..... **.75**

BINDING POSTS

The appearance of an instrument is often spoiled by a poorly finished or an unfinished binding post. Its utility is limited by a poorly designed binding post. We have ever given most careful thought to the design of binding posts and have made special tools and jigs which insure a **uniform product.** All of our binding posts are carefully **polished and lacquered.** We manufacture in large quantities and are able to supply **finished binding posts** at prices which compare favorably with similar lines of inferior material, workmanship and finish.

Illustrations are full size.



No. 90–245
Each **$0.95**

No. 90–247
Each **$0.45**

No. 90–252
Each **$0.35**

No. 90–260
Each **$0.25**

No. 90–264
Each **$0.22**

No. 90–265
Each **$0.20**

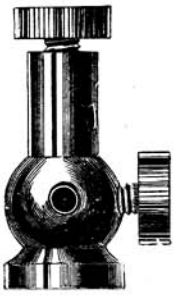
No. 90–272
Each **$0.40**

No. 90–284
Each **$0.25**

No. 90–290
Each **$0.30**

No. 90–295
Each **$0.36**

No. 90–299
Each **$0.40**



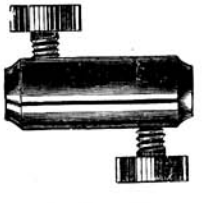
No. 90–282
Each **$0.48**

No. 90–274
Each **$0.33**

No. 90–275
Each **$0.22**

No. 90–286
Each **$0.20**

No. 90–288
Each **$0.20**



No. 90–310
Each **$0.18**

No. 90–312
Each **$0.16**

90–315 TRIPLE CONNECTORS.....Each **$0.35**

NEW LINE SQUARE SLOT BINDING POSTS

LARGE CARRYING CAPACITY NON-DETACHABLE HEADS

The Square Slot Binding Posts have three accurately machined parts — the main body, sliding shoe and knurled screw cap. A square slot is milled the entire width of the main body, the base of the slot forming one of the contact surfaces, and the sliding shoe which operates in this slot forming the other contact surface. The knurled screw cap is spun on after all parts are assembled, and by simply tightening it with the fingers a positive contact is assured. The base of the post is tapped for standard machine screws and to eliminate doweling the base of the post is knurled. This binding post will grip lead wires or terminals as fine as **No. 45** wire.

Illustrations are full size

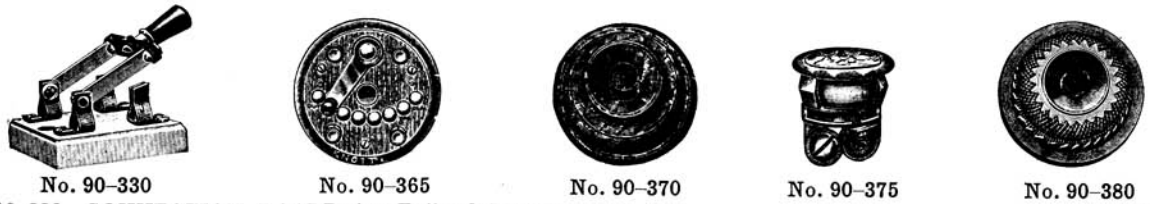
No. 90-316A **No. 90-316B** **No. 90-316C** **No. 90-316D** **No. 90-316E** **Open** **Closed** **No. 90-317**

Cat. No.	Diameter of Base	Ampere Range	Size of Slot	Price, Each
90-316A	3/8 inch	0–25	3/32 inch	**$0.25**
90-316B	1/2 inch	0–50	1/8 inch	**.35**
90-316C	5/8 inch	0–100	5/32 inch	**.50**
90-316D	3/4 inch	0–150	3/16 inch	**.85**
90-316E	7/8 inch	0–300	1/4 inch	**1.25**

90-317 THE POTENTIAL BINDING POST. This post has same unique structural details as the above but has an added feature in that the knurled top is insulated all over and the base is equipped with a pin which prevents the post from turning. Diameter of base, 5/8 inch, ampere range 0–100, size of slot 5/32 inch, stud 3/4 inch long, threaded 8×32 ..... Each **.65**

SWITCHES, ETC.

No. 90-325 **No. 90-327** **No. 90-352** **No. 90-340**

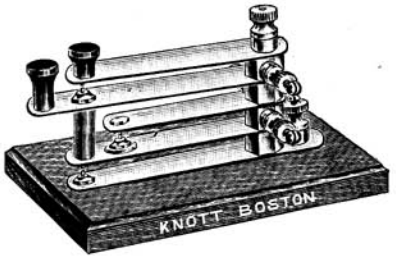


No. 90-330 **No. 90-365** **No. 90-370** **No. 90-375** **No. 90-380**

90-320	**CONNECTION BOARD** (see Fuller & Brownlee, Exp. 76)	**$5.50**
90-325	**SINGLE-POLE, SINGLE-THROW KNIFE SWITCH,** 15 amperes, porcelain base	**.90**
90-327	**SINGLE-POLE, DOUBLE-THROW KNIFE SWITCH,** 15 amperes, porcelain base	**1.50**
90-330	**DOUBLE-POLE, SINGLE-THROW KNIFE SWITCH,** 15 amperes, porcelain base	**1.00**
90-332	**DOUBLE-POLE DOUBLE-THROW KNIFE SWITCH,** 15 amperes, porcelain base	**1.60**
90-340	**POINT SWITCH, one-point,** wood base, brass terminals	**.28**
90-342	——, two-point	**.35**
90-350	**RUBBER BASE POINT SWITCH, one-point,** binding posts on front	**1.50**
90-352	——, two-point	**1.85**
90-354	——, three-point	**2.15**
90-356	——, four-point	**2.50**
90-365	**BATTERY RHEOSTAT AND SWITCH, 5 ohms,** six steps, polished wood base, hard rubber handle	**1.75**
90-370	**WOOD PUSH BUTTON,** hard rubber button	**.20**
90-375	**DESK PUSH BUTTON for 5/8-inch hole,** nickel-plated trim, light pearl button	**.50**
90-380	**METAL PUSH BUTTON, 2 3/8 inches,** ornamented metal base, hard rubber button	**1.00**

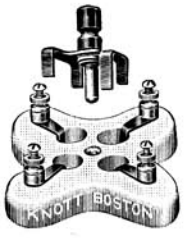
No. 90–390

No. 90–392

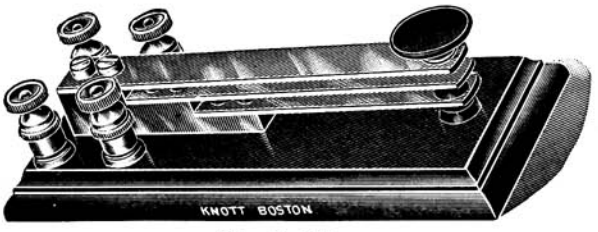


No. 90–395

No. 90–480



No. 90–470



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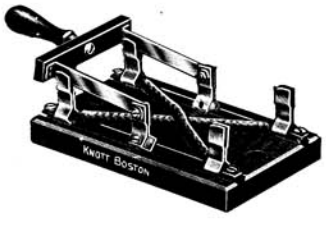

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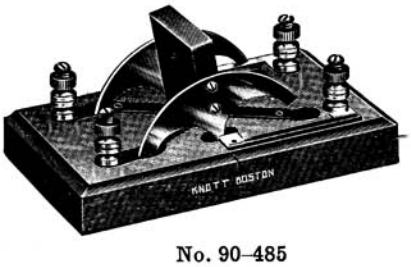


No. 90–485

No. 90–475

90–390 **SINGLE CONTACT KEY, open circuit,** wood base..... **$1.50**

90–392 **DOUBLE CONTACT KEY, open circuit,** binding posts for each circuit, wood base..... **5.25**

90–395 **DOUGLASS UNIVERSAL DOUBLE CONTACT KEY.** This key serves about every possible use in the laboratory with the exception of high capacity condenser work. It can be used to close a single circuit, open a single circuit, close two separate circuits, close one circuit and open another simultaneously, open one circuit and close another, close one circuit, open the second and close the third in one movement, and many other ways which readily present themselves when once in use..... **9.00**

90–410 **HIGH INSULATION DOUBLE CONTACT KEY.** A high grade key especially designed for use when extra high insulation is required. Heavy ebonite blocks and base, extra large binding posts and heavy platinum contact. All parts well made and finished..... **20.00**

90–470 **PORCELAIN BASE COMMUTATOR or POLE CHANGER.** Easily cleaned, impossible to get out of order..... **1.65**

90–475 **SPLIT RING POLE CHANGER.** Heavy phosphor-bronze contact clips..... **4.25**

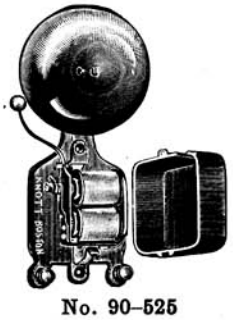
90–480 **PALMER'S PLUG FORM POLE CHANGER.** Current reversal secured by tapered brass plugs. The curved brass blocks with tapered holes between are mounted on an insulating base as illustrated..... **5.50**

90–485 **BLOCK HANDLE POHL'S COMMUTATOR.** This pole changer is of the rocking type, assuring instant current reversal by merely tipping from one pair of mercury wells to the other..... **4.00**

90–490 **KNIFE SWITCH POLE CHANGER, 15 amperes.** Slate base with open connections..... **2.85**

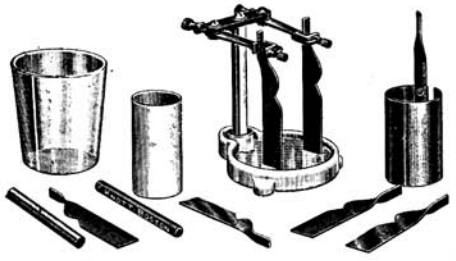
90–525 **DISSECTIBLE IRON BOX BELL,** 2½-inch gong..... **.90**

90–545 **DISSECTIBLE IRON CLAD BUZZER**..... **.85**



No. 90–525

BATTERIES



No. 91–15

No. 91–42

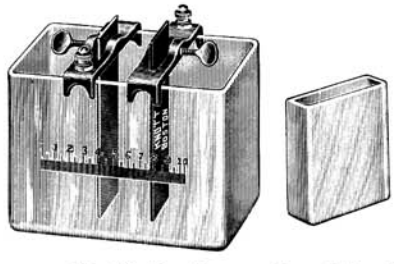
91–10 **PORCELAIN BASE GILLEY SKIDMORE BATTERY STAND** for supporting the various accessories **Nos. 91–15a** to **91–15k** in the study of principles of simple, voltaic, and various forms of primary batteries. The base is molded porcelain, glazed; the rod is non-corrosive metal; the element clamps are adjustable on the insulating strip on top of the rod. Battery stand only..... **$1.80**

91–12 **PORCELAIN BASE GILLEY SKIDMORE DEMONSTRATION CELL.** A single fluid cell consisting of **Nos. 91–10, 91–15a, 91–15e** and **91–15f**..... **2.10**

91–15 **PORCELAIN BASE GILLEY SKIDMORE BATTERY STUDY OUTFIT.** Consists of **No. 91–10** Stand and Accessories **Nos. 91–15a** to **91–15k,** complete.. **3.50**

91–30 **GOTHAM DEMONSTRATION CELL.** Non-corrosive element holders adjustable along the top of a rectangular glass jar having a millimeter scale etched along the front. With zinc and copper elements as illustrated..... **4.75**

91–35 **GOTHAM DEMONSTRATION BATTERY STUDY OUTFIT.** Consists of **No. 91–30** with addition of a rectangular porous cup, round carbon and zinc elements and flat elements of aluminum, carbon, iron, lead, nickel and tin..... **6.25**



No. 91–30 Porous Cup of No. 91–35

91–40 **HALL'S PORCELAIN-CAPPED DEMONSTRATION CELL.** The cap is molded porcelain, glazed. The adjustable metal element holders are attached to this cap. With **Nos. 91–43, 91–47** and **91–48,** to form a simple voltaic cell..... **1.55**

91–42 **HALL'S PORCELAIN-CAPPED BATTERY STUDY OUTFIT.** Consists of glazed porcelain cap with element holders and accessories **Nos. 91–43** to **91–54** inclusive..... **3.10**

Separate Parts

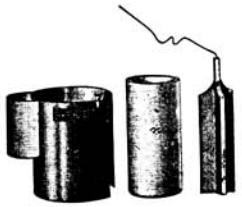
For GILLEY SKIDMORE BATTERY STUDY OUTFIT

91–15a	Glass Jar	**$0.10**
91–15b	Porous Cup, 3×7.5 cms.	**.30**
91–15c	Zinc Pencil, ⅜ inch diameter	**.12**
91–15d	Carbon Pencil, ⅜ inch diameter	**.12**
91–15e	Zinc Element	**.10**
91–15f	Copper Element	**.10**
91–15g	Iron Element	**.08**
91–15h	Aluminum Element	**.12**
91–15i	Lead Element	**.12**
91–15j	Pure Block Tin Element	**.25**
91–15k	Copper Cylindrical Element	**.35**

For HALL'S BATTERY STUDY OUTFIT

91–43	Glass Jar	**$0.10**
91–44	Porous Cup, 3×7.5 cms.	**.30**
91–45	Zinc Pencil	**.12**
91–46	Carbon Pencil	**.12**
91–47	Zinc Element	**.08**
91–48	Copper Element	**.08**
91–49	Lead Element	**.10**
91–50	Iron Element	**.07**
91–51	Aluminum Element	**.10**
91–52	Tin Element	**.20**
91–53	Copper Cylindrical Element	**.35**
91–54	Carbon Element	**.12**

91–25 **TAPERING ZINC ELEMENT** for use with above outfits in the study of polarization..... **.08**

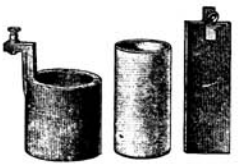


No. 91–80 No. 91–79
No. 91–77

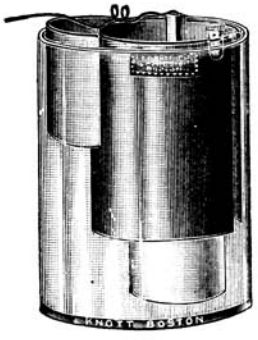
No. 91–92

No. 91–107

No. 91–110



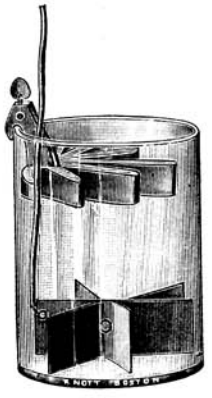
No. 91–169 No. 91–170
No. 91–167



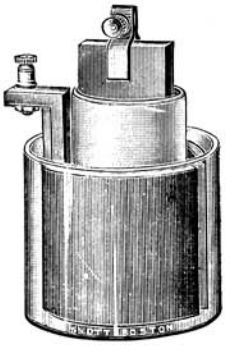
No. 91–75

No. 91–94

No. 91–96



No. 91–105



No. 91–165

91–65 **LECLANCHE BATTERY** for "open circuit" work, especially for bell service. E.M.F. about 1.4 volts. Complete **$1.25**
91–67 Porous Cup **$0.85**
91–68 Zinc Pencil ..... **.15**
91–69 Glass Jar ..... **.35**

91–75 **GALLON STANDARD DANIELL CELL** for "open and closed circuit" work. Constant E.M.F. about 1.08 volts. This is the best cell for electrical experiments. Complete **3.85**
31–265c Glass Jar, 6×8 inches **$0.60**
91–77 Porous Cup ..... **.55**
91–79 Zinc Element ..... **.90**
91–80 Copper Cylinder with pocket **1.80**

91–90 **QUART STUDENTS' DANIELL CELL.** Copper and zinc elements, and porous cup as illustrated, with glass jar. Complete **1.30**
91–92 Porous Cup, 2×4 inches **$0.35**
91–94 Zinc Element with Binding Post ..... **.25**
91–96 Copper Element ..... **.30**
31–265b Glass Jar, 4×5 inches ..... **.40**

91–105 **GALLON CROWFOOT GRAVITY CELL** for "open circuit" work — largely used by telegraph and telephone companies. Complete **1.60**
91–107 Crowfoot Zinc Element **$0.75**
91–110 Copper Element ..... **.25**
31–265c Glass Jar, 6×8 inches ..... **.60**

91–165 **BUNSEN CELL, one quart,** for "open circuit" work. E.M.F. about 1.9 volts, internal resistance about 1.8 ohms. Complete **2.85**
31–265bb Glass Jar, 4½×4½ inches **$0.55**
91–167 Porous Cup, 2½×5 inches ..... **.45**
91–169 Zinc Element with Binding Post **1.40**
91–170 Carbon Element with Connector and Binding Post **.45**

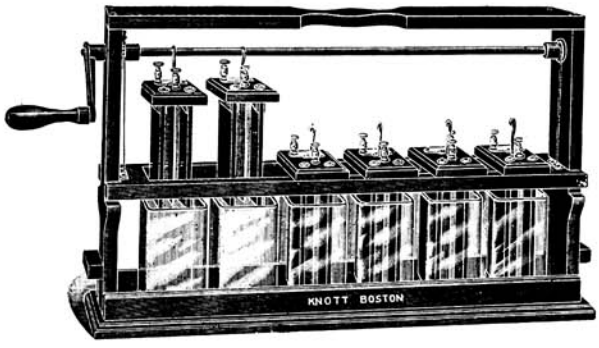
91–180 **GRENET BATTERY, one pint.** E.M.F. 2 volts with small internal resistance giving powerful current for a short time. Element can be raised and clamped out of the solution, thus stopping action and preserving strength of the solution. Complete **3.90**
91–182 Zinc Element **$0.45**
91–184 Carbon Element ..... **.45**

91–190 ——, **quart size.** Complete **5.50**
91–192 Zinc Element **$0.80**
91–194 Carbon Element ..... **.80**

91–205 ——, **two-quart size.** Complete **7.00**
91–207 Zinc Element **$0.95**
91–209 Carbon Element ..... **.95**

No. 91–190

WATER BATTERIES. See page 135.

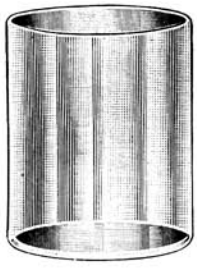


No. 91–225

91–225 HIGH SCHOOL PLUNGE BATTERY, six cell. Each cell is a unit in itself and will deliver about 2 volts and a powerful current for a short time. The mounting is designed so that one or more cells, connected in series or parallel, may be used as desired. The illustration shows four cells in use, the two not in use suspended to the cross rod. By turning the crank all of the cells can be raised at one time, the tops resting on the frame raised by the crank. Complete as illustrated..... **$38.00**

91–227 ——, **four-cell,** complete..... **30.00**

91–229 Complete Element — top, two carbon and the zinc element..... **4.00**
91–231 Carbon Element..... **.60**
91–233 Zinc Element..... **.95**
91–380A Square Battery Jar..... **.75**



No. 31–265

No. 91–380

No. 91–280

91–280 MOUNTED H-FORM STANDARD CELL. Consists of **No. 91–282** Standard Cell, mounted as illustrated..... **4.50**

91–282 H-FORM STANDARD CELL — glass part only with sealed-in platinum electrodes, arranged so that the students can make their own standard cell..... **3.00**

91–300 DRY CELL, standard grade, selected after years of experimentation, for length of life, high E.M.F. and low internal resistance, and in that it polarizes slowly and recovers rapidly..... **.60**

31–265 BATTERY JARS, excellent quality.

	a	b	bb	c	d
Size, inches	2¼×3¼	4×5	4½×4½	6×8	8×12
Each	**$0.28**	**.40**	**.55**	**.60**	**2.25**

91–380 RECTANGULAR BATTERY JARS, excellent quality.

	a	b
Size, inches	2½×4¼×7	4×4×8
Each	**$0.75**	**1.00**

A B C

No. 91–410

91–410 CARBON AND ZINC BATTERY CONNECTORS.

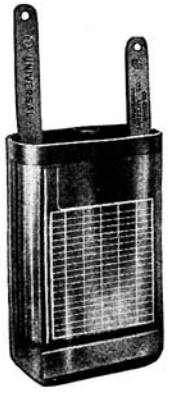
	a	b	c
For plates, inches thick	¼ to ⅜	⅜ to ¾	¾ to 1¼
Each	**$0.45**	**.60**	**.80**

91–425 POCKET D. C. VOLTMETER, 0–10 volts, for testing voltage of a battery..... **1.40**

91–426 POCKET D. C. AMMETER, 0–35 amperes, for testing the amperage of a battery..... **1.40**

91–427 POCKET D. C. VOLT-AMMETER, 0–10 volts, 0–35 amperes, for testing the strength of a battery. **1.85**

91–315 MOUNTED LEAD PLATES (See Millikan & Gale, Fig. 277) ..... Per pair **$1.90**



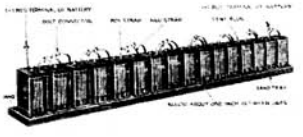
No. 91–327

UNIT-SEALED GLASS STORAGE CELLS

Fully Charged

Plates hand pasted, uniform in weight and finish. Strong soft wood separators run full length of plates. Plates and separators are supported at the bottom by a heavy cast lead bridge, properly insulated, which carries the weight of the plates, thus avoiding breaking of the cover and displacement of the plates. Connectors are heavy, the negative longer than the positive to facilitate assembling to form a battery of two or more cells (see illustration, 16 cells). Sealing compound will not crack nor will it become too soft in hot weather. It adheres to the glass jar and to lead terminals, prevents any escape of acid, retards evaporation and avoids danger of foreign substances entering the cell. The glass jar is a perfect insulator and permits the general conditions of the cell to be seen at all times.

Each cell is shipped **fully charged** ready for use.



16 Cells— No. 91–329
Set up on shallow wooden trays filled with sand. Short strap positive, long strap negative

91–327 ——, **3-plate type,** 8 ampere hours at 8-hour rate, 12 ampere hours at intermittent rate. Jar measures outside, 4×2½×6½ inches high **$4.50**

91–328 ——, **5-plate type,** 16 ampere hours at 8-hour rate, 23 ampere hours at intermittent rate. Jar measures outside, 4×2½×6½ inches high **5.75**

91–329 ——, **7-plate type,** 66 ampere hours at 8-hour rate, 95 ampere hours at intermittent rate. Jar measures 6¼×3×9½ inches high. (Illustration shows a battery of sixteen of these cells) **12.00**

PORTABLE STORAGE BATTERIES

Fully Charged

Nos. 91–337
91–339

91–337 FOUR-CELL PORTABLE STORAGE BATTERY. The construction of the individual cells is the same as described above, but the cells are mounted in hard rubber jars and assembled in wood cases, finished with black acid-resisting paint; **9 plates per cell,** 88 ampere hours at 8-hour rate, 128 ampere hours at intermittent rate **$75.00**

91–338 ——, **11 plates per cell,** 110 ampere hours at 8-hour rate, 160 ampere hours at intermittent rate.. **85.00**

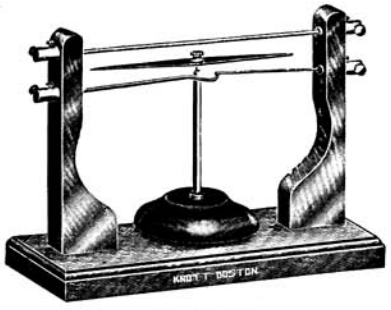
91–339 ——, **13 plates per cell,** 180 ampere hours at 8-hour rate, 260 ampere hours at intermittent rate.... **115.00**

Rating of Batteries

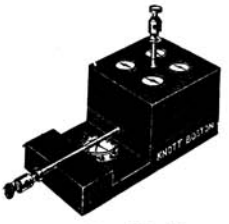
Two ratings are given for each of the cells listed above. Ratings have usually been given on our 8-hour discharge basis which is a continuous discharge over one 8-hour period. The Intermittent Rating is the discharge over a 72-hour period with three rest periods.

TUNGAR RECTIFIERS. See page 180.

ELECTRO-MAGNETISM



No. 92–20



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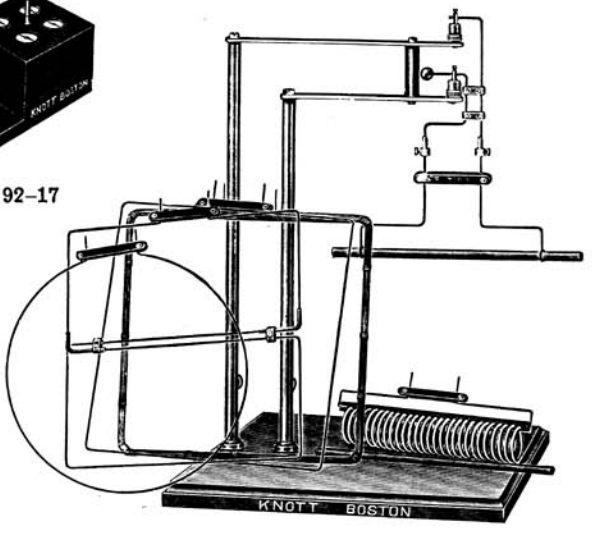

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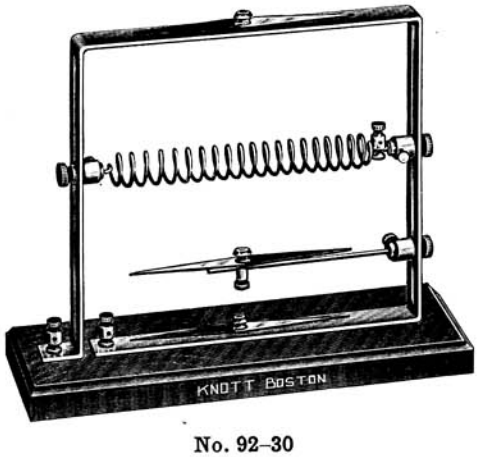


No. 92–30

No. 92–15

No. 92–60

92–15 **AMPERE'S LAW STAND** (see National Physics Direction Sheets, Exp. E041) for the study of the magnetic field about a current-bearing conductor. In this new design the magnetic field can be located by small compasses as illustrated or by the iron filings method. Without compasses **$3.75**

92–17 **AMPERE'S LAW STAND** (see Fuller & Brownlee, Exp. 81) for the study of the magnetic field surrounding a current-bearing conductor. Without movable magnetic compass, but otherwise complete as illustrated with the four small compasses sealed into the block **4.25**

92–20 **OERSTED'S LAW APPARATUS** for study of magnetic action of currents and formulating Ampere's rule. Complete as illustrated with **No. 81–12** Magnetic Needle **5.35**

92–22 **——, without No. 81–12 Magnetic Needle** **4.25**

92–30 **HELIX OERSTED'S LAW APPARATUS** for the study of the directive action which a fixed current exerts at a distance on a magnetic needle, and for formulating Ampere's rule. The helix and one magnetic needle are movable on the upright sides of the frame; the magnetic needle is also movable along the holder. An electric current can be connected through the helix or around the frame. Complete as illustrated **9.75**

92–35 **——, without Helix and the Two Fixed Magnetic Needles.** The movable magnetic needle can be adjusted along the frame as desired **6.00**

92–37 **HELIX ATTACHMENT** for use on above. This attachment is illustrated over **No. 92–30** **2.20**

92–40 **BAR OF IRON** and **BAR OF WOOD** for use within Helix Attachment **No. 92–37** for study of the magnetic effects ..... **.35**

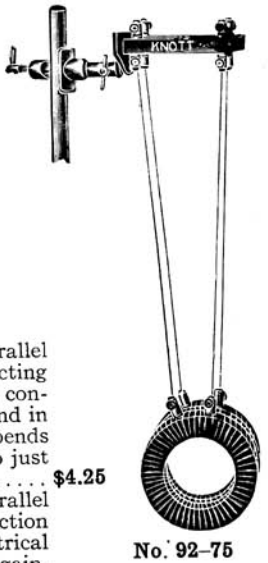
92–50 **AMPERE'S FRAMES AND SUPPORT.** Consists of a finely finished support with balanced and insulated holder for the various frames. Five frames are supplied: loop, plain rectangle, astatic rectangle, rectangular coil, and a solenoid.

Serves to demonstrate in a positive striking manner mutual action of magnets and solenoids, action of currents on solenoids, directive action of the Earth on solenoids, directive action of magnets on currents, "sucking" effects of solenoids and action of a current on a pivoted magnet. Complete as illustrated **19.50**

92–60 **FLOATING HELIX AND CELL** for demonstrating the magnetic polarity of an electro-magnetic solenoid. This combination will float upright in a jar of water. When the battery solution is placed in the small jar in the center of the cork disc, the solenoid will act the same as a magnetic needle, one end developing South and the other end North polarity **2.50**

No. 80–305

No. 80–310



No. 92–75

80–305 **PARALLEL CURRENT APPARATUS** for demonstrating mutual actions of parallel currents. Parallel currents flowing in the same direction are secured by connecting both binding posts with one pole of the battery. The other pole should be connected to a binding post (not shown in the illustration) fastened to the base and in electrical connection with the mercury well. Success of the experiment depends upon amalgamating the ends of the copper rods and upon allowing the rods to just make contact with the surface of the mercury **$4.25**

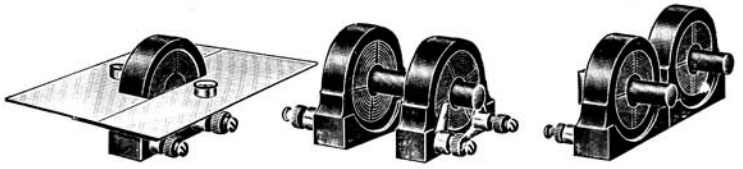
80–310 **VIBRATING SPIRAL APPARATUS** for illustrating mutual action of parallel currents. When a current is allowed to pass through the spiral, there is an attraction between the convolutions, causing the lower end of the spiral to break the electrical connection with the mercury. The weight of the spiral then causes contact again, which, in turn, sets up attraction of the convolutions. Continual making and breaking contact with the mercury causes this spiral to vibrate up and down **4.25**

92–75 **PARALLEL CURRENT REPULSION COILS, Bi-Filar Suspension,** for illustrating mutual influence of parallel currents and self induction. The coils have 1000 turns of wire, are form wound, taped, shellacked, and baked. Terminals are attached to loops for bi-filar suspension. The support for the coils consists of two hard rubber pieces, adjustable on a cross head so that the distance between the coils can be varied. This cross head is attached to a rod which fits the clamp. Two sets of binding posts for series or multiple connections; coils wound for 110 volts when connected in series. Without stand but otherwise complete as illustrated **12.50**

92–77 **MAGNETIC INDUCTION COIL.** A form wound coil for use with any sensitive galvanometer to conduct various experiments showing the earth's magnetic field and other induction phenomena .. **4.25**

ELECTRO-MAGNETS

Figures 1 2 3 4 5 6



Figures 7 8 9

Nos. 92–110 to 92–130

92–110 **GILLEY INDUCTION COILS** (see National Physics Direction Sheets, Exps. E042, E150 and E153) for study of electro-magnets and electro-magnetic induction. The coil is form wound, shellacked and baked. It is encased in a molded insulating compound and the ends terminate in binding posts. A pair of these coils with various accessories illustrated above and listed below, serve to cover a wide field in the study of electro-magnetism, self and mutual induction. ..... Per pair **$2.75**

Accessory Parts for Gilley Induction Coils

92–115 **SOFT IRON U-SHAPED CORE** (Fig. 3) for study of bi-polar electro-magnets (Exp. E042) ..... **.50**

92–117 **SOFT IRON ARMATURE** (Fig. 2) for use with above ..... **.20**

92–120 **SOFT IRON CORE** (Fig. 5) for study of currents induced by electro-magnetism (Exp. E153) .... **.20**

92–122 **HALF-ROUND CORE PIECES** (Fig. 4) for mapping lines of force (Exp. E042) ..... Per pair **.30**

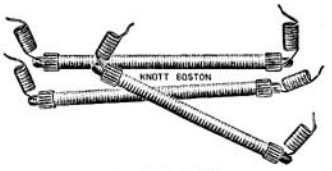
92–125 **SLOTTED CARDBOARDS** (Fig. 7) for mapping lines of force (Exp. E042) ..... Per pair **.15**

Figs. 8 and 9 in the illustration show how the apparatus is used in the study of the Simple Transformer, Induced Currents and Electro-magnets.

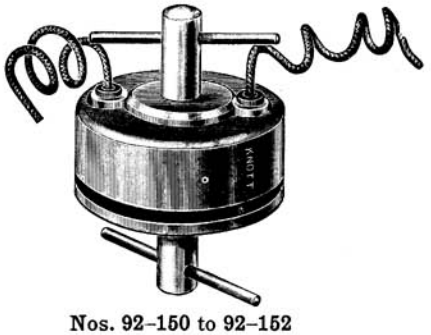
92–130 **GILLEY INDUCTION STUDY OUTFIT — Nos. 92–110** to **92–125** inclusive, in box with directions **4.00**

92–135 ELECTRO-MAGNETIC COILS (see Fuller & Brownlee, Exp. 82) for the study of the construction of an electro-magnet and to determine the conditions of its operation. A set of three coils varying in number of turns and the character of core. Per set of three..... **$1.95**

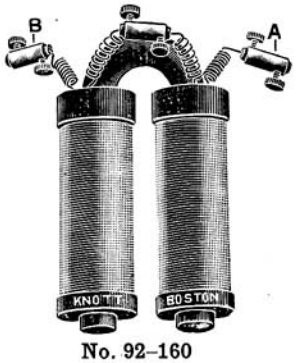
92–136 ELECTRO-MAGNETIC COILS (see Millikan, Gale & Bishop, Exp. 30), a pair of coils similar to the above.....Per pair **1.30**



No. 92–135



Nos. 92–150 to 92–152



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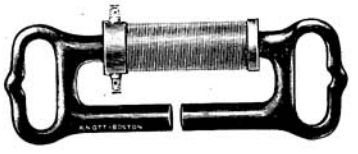


No. 92–175

92–150 INSTITUTE IRON CLAD MAGNET, 300 lbs. capacity. This magnet has been patterned after the commercial types of lifting magnets. The cross sectional area of the shell is equal to that of the core, thus giving the highest efficiency per lb. Size, 4×1½ inches; weight with armature, 5 lbs.; resistance, ⅓ ohm. Recommended for use on 4 to 6 volts..... **$9.00**

92–152 INSTITUTE IRON CLAD MAGNET, same construction as above, but smaller in size..... **5.00**

92–160 DEMONSTRATION ELECTRO-MAGNET, 6-inch, for battery current. The two windings can be connected in multiple or series. Recommended for use on 5 to 10 volts. Complete as illustrated **4.75**

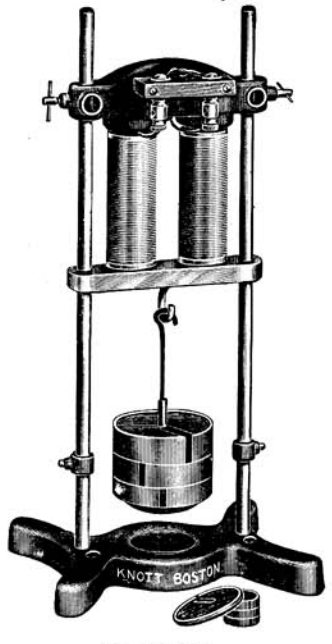
92–165 HELIX ELECTRO-MAGNET, 4½-inch, N. Y. State form..... **2.50**

92–175 HELIX AND SEPARABLE MAGNETIC CIRCUIT (HELIX AND RING). A form wound coil and two soft iron U-shaped cores with cast metal handles assembled as illustrated. Recommended for use on 4 to 6 volts..... **$5.00**

No. 92–185

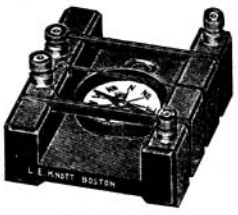
92–185 SOLENOID MAGNET for illustrating the principle of a solenoid magnet. Consists of a form wound coil over a heavy walled glass tube in which is placed a soft iron rod. Complete as illustrated..... **2.95**

92–200 110-VOLT LIFTING MAGNET, 300 lbs. capacity. As may be noted from the illustration, the core piece has been so designed that the magnet may be used as shown or reversed so that the poles extend vertically upward or in a horizontal position with the poles extending outward. Height of frame, 25 inches; net weight of magnet without frame, 10 lbs; diameter of core, one inch; size of winding, 4¾×1¾ inches; resistance, 220 ohms; ampere consumption, 0.5 amp.; capacity, 300 lbs.; wound for 110 volts. Without weights..... **45.00**

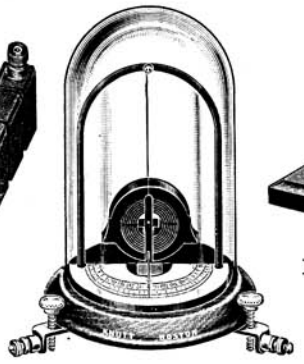


No. 92–200

ELECTRICAL MEASURING INSTRUMENTS

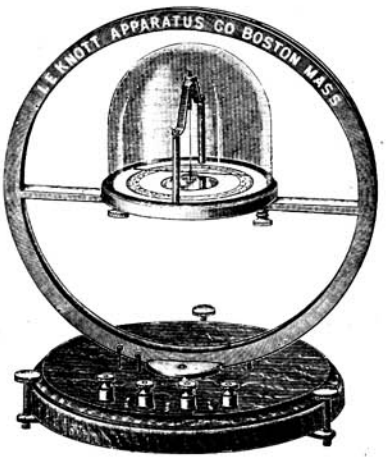


No. 93–12



No. 93–30

Nos. 93–40 to 93–50



No. 93–60

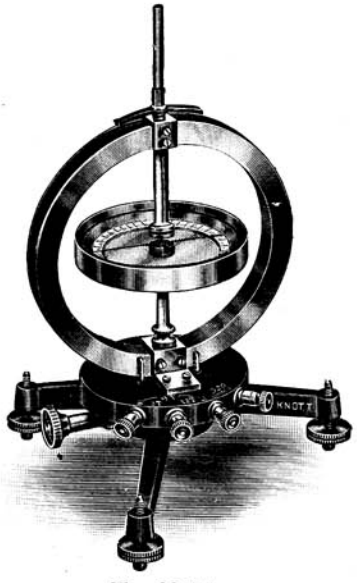
93–12 **GALVANOSCOPE** (see Millikan, Gale & Bishop, pp. 80–100), three separate circuits, 1, 25 and 100 turns; binding post for each circuit. Without compass **$2.20**

93–30 **TROWBRIDGE ASTATIC GALVANOMETER.** An experience of over a quarter of a century has demonstrated that this instrument is much superior to the conventional types of static galvanometers. The instrument is constructed on the close coil principle in which the magnet is suspended from a light aluminum vane hanging in front of the coil. Coils of varying resistances may be supplied if desired. The coil with which the instrument is furnished is intended for Wheatstone bridge work and other experiments where the voltage is exceedingly low. The end of the aluminum vane projects into a metal cup under the coil which, for purposes of making the instrument dead-beat, may be filled with glycerine if desired. The actuating coil is clamped in metal clips and may be easily removed. All parts of this instrument are clearly exposed. The instrument is nearly "dead-beat" and by use of an outside control magnet, a great variation in sensibility can be obtained **11.50**

93–40 **STUDENTS' TANGENT GALVANOMETER, six-inch oxidized brass ring.** Arranged with binding posts which connect to 5, 10 or 15 turns of wire. All connections exposed so that the student can trace the direction of the current. With brass-capped, card-dial compass **3.75**

93–44 ——, with **agate-bearing compass,** raised metal dial with full circle divisions **5.20**

93–50 ——, with **agate-bearing compass, aluminum pointer,** raised metal dial with full circle divisions **5.85**



No. 93–75

93–60 **HARCOURT 22-CM. TANGENT GALVANOMETER, cast metal ring.** Arranged with binding posts connecting 5, 10 or 15 turns of wire. Compass box is about 11 cms. diameter and is provided with 2-cm. fiber suspended magnet with aluminum pointer moving over a mirror dial. This compass box is removable by loosening two set screws which enables the instrument to be used in a variety of experiments on induction. This galvanometer has all the essentials of the higher-priced instruments **11.50**

93–75 **STANDARD TANGENT GALVANOMETER** with **Thompson Adjustable Control Magnet.** Finished brass ring, 20 cms. in diameter with coil 13 mm. wide mounted on polished hard rubber, swiveled on a tripod base with leveling screws. The suspension system consists of a needle 15 mm. long, suspended by fiber and provided with a convenient and satisfactory lift. The needle is protected by a box 12½ cms. in diameter, provided with silvered engine-divided dial. Windings have been most carefully worked out to meet the conditions of the greatest variety of experiments,—

3 turns coarse wire, posts 1 and 2, wound clock-wise.

12 turns coarse wire, posts 2 and 3, wound counter clock-wise, giving, between posts 1 and 3, 9 turns of coarse wire wound counter clock-wise.

320 turns fine wire, posts 3 and 4, wound clock-wise, especially designed for determining the constant of a tangent galvanometer.

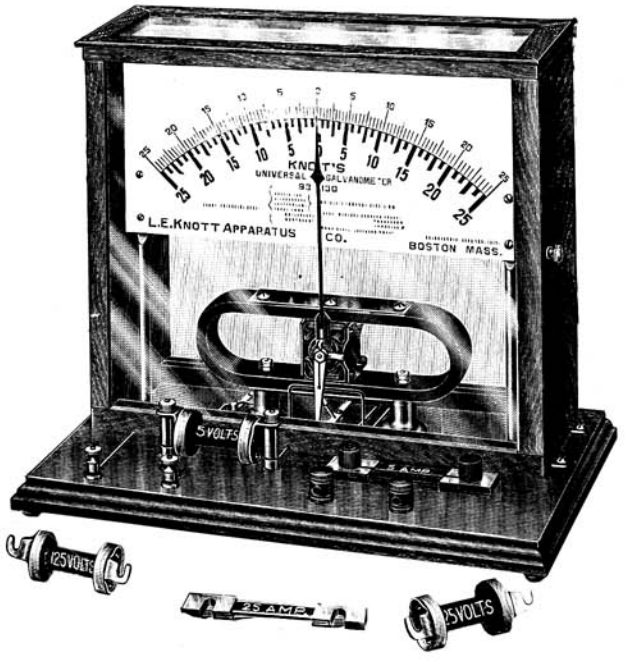
This galvanometer is one of the most carefully designed and scientifically proportioned instruments on the market **45.00**

UNIVERSAL LECTURE TABLE GALVANOMETER

No. 93–130

Eight Instruments in One

1. **Galvanometer** — one space deflection means .002 ampere or .002 volt.
2. **Millivoltmeter** — range 25 millivolts reading to ½ millivolt.
3. **Milliamperemeter** — range 25 milliamperes reading to ½ milliampere.
4. **Voltmeter** — range 0–5 volts reading to 1/10 volt.
5. **Voltmeter** — range 0–25 volts reading to ½ volt.
6. **Voltmeter** — range 0–125 volts reading to 2½ volts.
7. **Ammeter** — range 0-5 amperes reading to 1/10 ampere.
8. **Ammeter** — range 0–25 amperes reading to ½ ampere.



The original design of this Universal Lecture Table Galvanometer was offered the teaching profession over a decade ago. We offer in our present design an instrument which has gradually been improved in accordance with valuable suggestions that have been made by experienced teachers.

Movement. Commercial D'Arsonval type, slightly modified, the moving coil adjusted for one ohm resistance, making it possible to supply at any time detachable and interchangeable shunts or resistances of any desired range.

Connections. All connections are in plain view. Resistances and shunts are connected as shown in the illustration.

Dial. The dial is 12 inches long. Note the double scale — the lower has alternate black and white spaces and large, distinct figures which can be seen from any part of the lecture room. The back of the dial carries a scale with full and explicit directions for connecting the instrument.

Calibration. Each instrument is hand calibrated in connection with the best standard commercial instrument.

Mechanism. The magnets are aged by the standard aging process. All bearings are jewelled. A protecting switch is provided on the base to avoid accidental burning out of the coil. The zero adjustment is simple and even the most inexperienced is enabled to adjust the pointer to the zero reading. The knurled head at the right of the case operates a device to lock the pointer.

Educational Features. All connections and moving parts are plainly in view. Without shunts or resistances in circuit the instrument is a sensitive galvanometer, a millivoltmeter or milliamperemeter. By connecting various resistances in series the student is enabled to set up voltmeters of different ranges; by connection of shunts he is enabled to set up ammeters of different ranges.

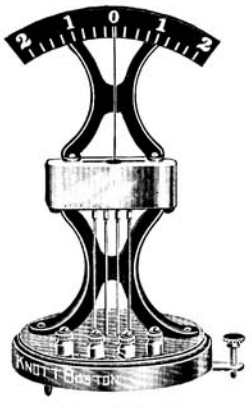
We believe this instrument to be the best electrically, mechanically, and educationally that has ever been produced. Complete with full set of shunts and resistances for ranges noted above.

PRICE, $75.00

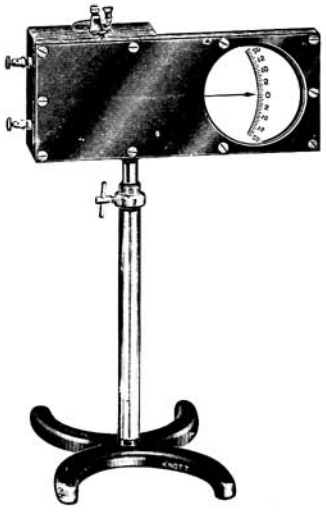
Gentlemen: Your Lecture Table Galvanometer has been a great help in teaching the subject of current electricity to mixed classes. The fact that all connections and moving parts are plainly in view, and the scale large and open, and the ranges large make it an ideal educational instrument. The use of the ammeter shunts and of the switch shunt, and their effects on the deflection of the needle, tend to clear up the subject of divided circuits.

I have it before my classes during our study of current electricity and use it constantly. It is a usable and extremely satisfactory instrument and one that should be in every Physics lecture room.

Very truly,
(Signed) ERNEST R. SMITH.



No. 93–145



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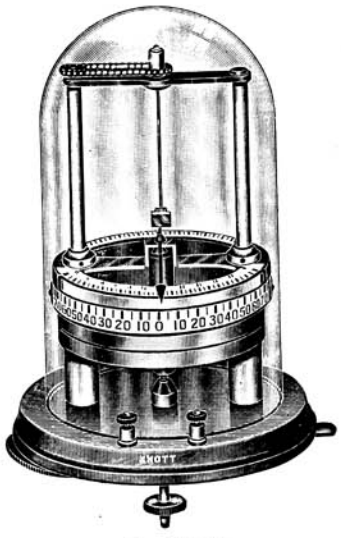


No. 93–175

93–145 LECTURE TABLE GALVANOMETER. This instrument is offered for use in simple lecture table experiments where high sensibility is not essential. The scale is large and open, the pointer is of aluminum, with jewel bearings; there are three sections of windings — coarse, medium, and fine wire of varying resistances, and varying ranges. Finished cast metal uprights, polished wood base..... **$13.50**

93–155 THE LAMPRA PROJECTION GALVANOMETER. This instrument is especially adapted for projection work, the scale chamber being of the regulation slide holder size with glass both sides of the indicator. The galvanometer movement is encased in a compact box mounted to give adequate adjustment for any form of projection lantern, the indicator moving over an arbitrary scale. The entire instrument, including the indicator chamber, is sealed for proper protection against dust and air currents. Complete as illustrated..... **43.75**

93–175 IMPROVED LAMINATED MAGNET LECTURE TABLE GALVANOMETER, 30 megohm sensibility. This is an instrument that one should see and use to fully appreciate its many excellent qualities. It has been designed to permit an entirely new field of experiments on the lecture table not possible with usual lecture-table instruments.

Important Features:

Laminated Magnets. Four magnets horizontally mounted. By reason of the form of the magnet and the fact that the whole system is laminated, we produce a magnetic pole strength at least five times that used in any other lecture-table magnet.

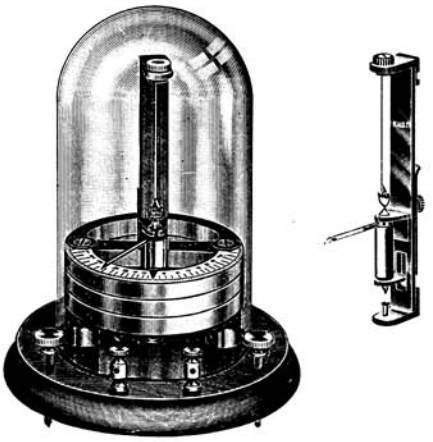
Coil. We have employed the cylindrical, close-wound coil recognized the world over as being the one form in which the deflections bear the proper relation to the current strength.

Scale Reading. We have employed a double-pointer reading on both sides of the instrument. The vertical scales, front and back, have coarse divisions for students' readings. The horizontal scales are for finer readings. The vertical scales are offset in such a way that the broad pointer does not overlap the scale but is in the same line with it, thus making it possible to use the so-called "straight line method of reading."

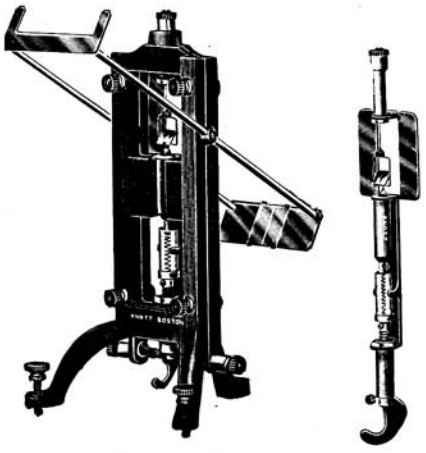
Sensibility, 30 megohms. This sensibility is possibly higher than required for some lecture-table work and can be reduced by connecting a coil in the form of a shunt.

Mechanism. The coil is adjusted to zero position by means of the knurled disc projecting slightly at the left of the base. A coil lift is also provided, operated without raising the glass dome. The method of attaching the suspension is novel. Should a suspension break, a new one can be obtained which even the most inexperienced can attach without the use of solder.

We believe that this instrument adequately fills a want that has made many experiments unsuccessful as lecture-table demonstrations. Electrically and mechanically, we have discovered no necessary or advisable improvement. Educationally, the instrument offers every opportunity for a careful study of the construction, since all parts are large and open to view through the glass dome..... **35.00**



No. 93–200



No. 93–210

HORIZONTAL D'ARSONVAL GALVANOMETER. See page 158.

93–200 **TRIPLE LAMINATED MAGNET HIGH SCHOOL GALVANOMETER, 30 megohm sensibility.** The educational value of the galvanometer illustrated is apparent. The simplicity electrically and mechanically will appeal to the many teachers who wish a galvanometer that can be depended upon to give satisfactory service in the wide range of laboratory experimentation.

The **Laminated Magnets** give greater magnetic strength, enabling heavier ribbon suspensions to be used, thus decreasing the liability of breakage. The **Coil** is of the close-wound type and forms part of the **Suspension System** which can be removed by loosening one screw. **Renewal of Broken Suspensions** is accomplished without use of solder or screw driver. The **Zero Adjustment** and **Coil Lift** are mechanically simple and operate by merely turning a knurled screw head. **Deflection Readings** are made directly by the pointer moving over a 3½-inch horizontal dial graduated in degrees **$9.00**

93–201 **UPPER SUSPENSION** ready for attachment ..... **.35**

93–202 **LOWER SUSPENSION** ready for attachment ..... **.75**

93–210 **LAMINATED VERTICAL MAGNET GALVANOMETER, 70 megohms sensibility.** It has been our purpose to construct an instrument which can be easily set up, adjusted and kept in adjustment, and one in which all working parts are constantly in view. The **Unit Suspension System,** shown in detail, carries the coil, upper and lower suspension, zero adjustment and coil lift, all constituting a single unit attached to the back base plate. **Suspensions** are supplied with metal terminals and broken suspensions can be replaced without the use of solder or screw driver, insuring a perfect electrical and mechanical contact. The **Lower Suspension** is now even more easily handled than the upper suspension. It is sent out as a sealed glass cartridge, the terminals passing through the upper and lower ends of the cartridge. After the coil is set in place and the adjustment made, the seal is cut away and the galvanometer is ready for use, all without touching the spiral with either tools or fingers.

The **Reading Device** is a modified form of that used on our original instruments. We employ the back target fiducial mark using a front opening wide enough for both edges to be used in their normal position without errors of parallax. By removing the reading device deflections can be read by telescope reading.

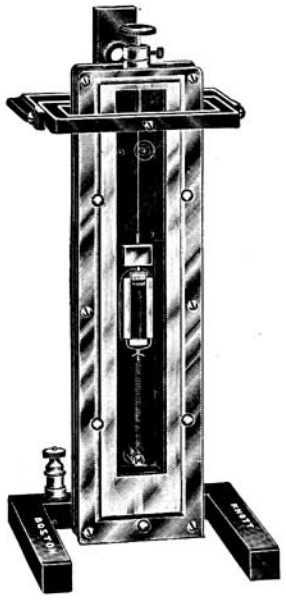
The **Sensibility** is 70 megohms, equal to all requirements for laboratory work; **resistance** approximately one ohm per megohm. The high sensibility, ease of reading, facility of renewing suspensions, and the electrical and mechanical features of this galvanometer, make it one that has appealed to many teachers, so that our sales have warranted quantity productions, enabling us to furnish a high grade instrument at a low price **12.50**

93–211 **UPPER SUSPENSION** ready for attachment ..... **.45**

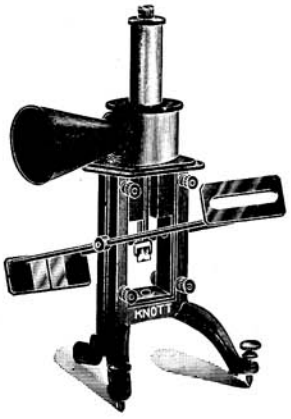
93–212 **LOWER SUSPENSION CARTRIDGE** ready for attachment **1.25**

93–215 **BALLISTIC COIL.** The galvanometer **No. 93–210** above is especially adapted for the use of Ballistic Coils in capacity and self-induction experiments. This coil is mounted on our unit suspension system described above all ready for replacing the system usually furnished with **No. 93–210.** Unit Ballistic System complete, ready for attachment **6.25**

Laminated Vertical Magnet Galvanometer No. 93–210 can be used to excellent advantage on Galvanometer Wall Bracket **No. 93–242.**



No. 93–230



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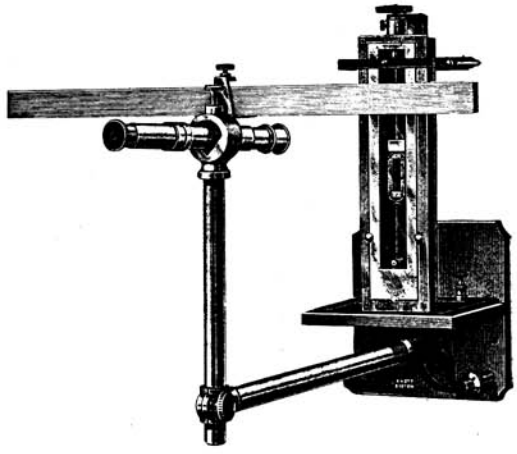


No. 93–245

93–230 **SELF-LEVELING D'ARSONVAL GALVANOMETER, 600 megohm sensibility.** This is a galvanometer designed particularly for advanced laboratory work. It can be used either as a wall or table instrument; is both **self-centering** and **self-leveling.** The instrument is hung from universal gimbals so that both magnet and coil are always in correct relation.

Magnet System. The material, form and method of treating employed produces a magnet of the greatest practical strength and permanency. The form of the coil and concentration of the lines of force have been carefully co-ordinated.

Coil System. The Coil System is removable, making for unusual accessibility and ready replacement of suspensions.

Sensibility. Sensibility of 600 megohms, with resistance of 400 ohms is a range which we have found most serviceable in our own testing laboratories.

Suspensions. By carefully adjusting the weight of the coil to the size of the phosphor-bronze suspension, we have practically eliminated the zero set.

Complete as illustrated **$75.00**

93–232 **EXTRA COILS — Ballistic, Low and High Resistance Coils,** will be furnished as specified ready for attachment on the above galvanometer **9.90**

93–242 **GALVANOMETER WALL BRACKET for use with any mirror reading galvanometer.** Heretofore sensitive galvanometers have been attached rigidly to the wall, it being necessary to level them with the greatest care. When once attached and adjusted, the galvanometer is allowed to remain on the wall permanently. Our rigid wall shelf for galvanometer work carries an arm as shown in the illustration. The vertical telescope and scale support is adjustable vertically and the whole arm is adjustable further by means of adjusting screws operating against the wall plate. The illustration pictures our Self-Leveling Galvanometer **No. 93–230,** Reading Telescope **No. 93–480,** and Galvanometer Scale **No. 93–244. Any mirror reading galvanometer can be used on this wall bracket.** Galvanometer Wall Bracket **only,** without galvanometer, telescope, and scale **35.00**

93–244 **GALVANOMETER SCALE,** 600 mm. divisions either side of 0 at the center, accurately graduated, figures inverted and reversed, graduations and figures clear and distinct **2.50**

93–480 **READING TELESCOPE WITH CROSS HAIRS,** objective 18 mm. diameter, focus ½ to 1 meter, sliding tube focusing adjustment, especially designed for use in electrical measurements **12.50**

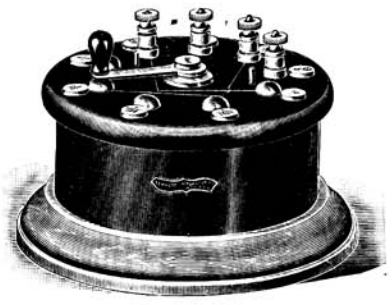
93–245 **SELF-LEVELING WALL GALVANOMETER OUTFIT** consisting of Galvanometer Wall Bracket **No. 93–242,** Self-Leveling D'Arsonval Galvanometer **No. 93–230,** Telescope **No. 93–480** and Scale **No. 93–244,** described above **125.00**

93–235 **RADIO MICROMETER,** an instrument long recognized as not only the most sensitive but also the most reliable heat indicator produced. In the design of this instrument we have used the fundamental parts of the D'Arsonval Galvanometer, but with the moving coil replaced by the most sensitive thermo-electric couple wihch it is possible to produce. We are able, therefore, to offer an instrument of **great sensibility.** A candle flame 50 feet distant will cause a marked deflection.

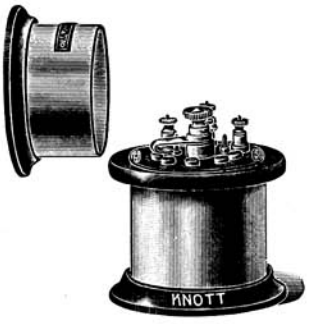
Our **Method of Reading** does not require the observer to remain at a considerable distance from the instrument when making readings. Readings by the telescope method will in some cases be found advisable yet for most of the experiments, readings can be made as in our D'Arsonval Galvanometer **No. 93–210.** The deflecting horn is mounted on a movable ring so that the heat can be received from either side only. The heat from the body of the observer, therefore, cannot affect the readings.

Complete as illustrated **32.00**

GALVANOMETER ACCESSORIES



No. 93–350

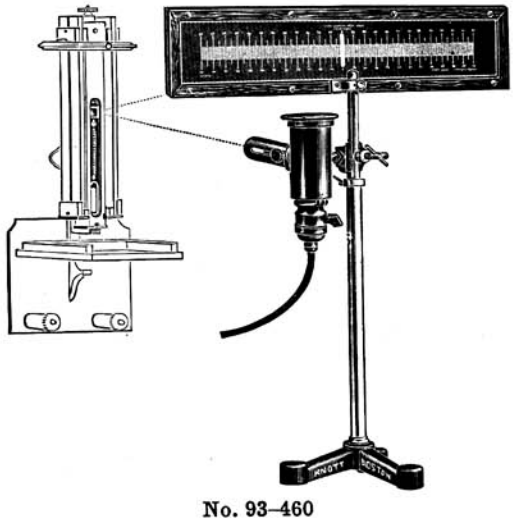


No. 93–360

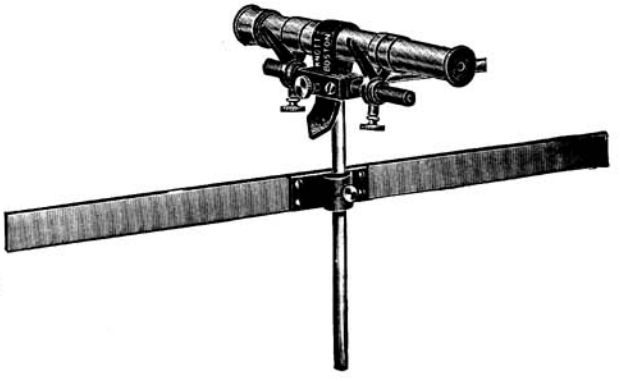
93–350 ELEMENTARY AYRTON UNIVERSAL SHUNT. In using a galvanometer of high sensibility it is necessary both for convenience and for protection of the galvanometer to use some device for reducing the strength of the current through the galvanometer. The instrument above illustrated provides in compact form a means of sending small or large fractions of the main current through the galvanometer, merely by a movement of the contact arm. This shunt is suitable for galvanometers with ranges from 50 to 500 ohms resistance **$19.00**

93–360 UNIVERSAL SHUNT. A great advantage of this shunt over the one preceding is that it can be used with a ballistic galvanometer as well as with a dead-beat instrument. The contact resistance is very low, although this is not a matter of great importance in the ordinary use of the instrument, as the contact resistance does not enter the galvanometer circuit proper. The circuit arrangements in our instrument are so arranged that the resistance coils are also available as a "drop wire," or simple potentiometer for subdividing a potential difference. To protect the ebonite top from air, dust, and sunlight, thus preserving its insulating properties, a brass cover with mahogany top similar in style to the box is provided. It lifts clear away from the box on loosening a bayonet catch and is laid aside while the shunt is in use.

	a	b	c
Total resistance, ohms	10,000	20,000	100,000
Each	$50.00	54.00	65.00



No. 93–460



No. 5–920 with
Nos. 93–470 and 93–480

93–460 LINE OR SPOT-OF-LIGHT DIRECT READING ADJUSTABLY MOUNTED LAMP AND SCALE for use with any reflecting galvanometer to give **direct readings** of the movement of the coil. The essential feature of this outfit is an incandescent lamp with ventilated housing. By means of a focusing device a brilliant line of light can be obtained that can be plainly seen in the ordinary lecture hall upwards of 75 feet away from the screen. Focused for a spot of light which is not so brilliant, the reflected spot can be plainly seen from a distance of 40 feet. If the room is slightly darkened, the spot of light or the line of light is more brilliant and, therefore, can be seen at a greater distance. The screen is opalescent and has a scale across the entire length with long centimeter divisions and shorter millimeter divisions. The screen and lamp are adjustably mounted as illustrated **48.75**

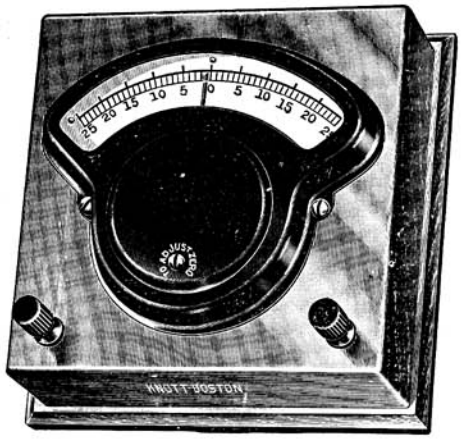
93–470 READING TELESCOPE SCALE. The scale on the front of the hardwood strip is 50 cms. long, graduated in long centimeter divisions and shorter millimeter divisions either side from zero at the center, figures inverted **3.25**

93–480 READING TELESCOPE WITH CROSS HAIRS, ½ to 1 m. focus. Designed especially for use in electrical experiments, but can be used equally well in experiments on the magnifying power of a telescope. Objective, 18 mm. diameter; focus, ½ to 1 m.; sliding focusing adjustment **12.50**

ELECTRICAL MEASURING INSTRUMENTS

D'Arsonval Movement

GALVANOMETERS — VOLTMETERS — AMMETERS



No. 93–195

The line of instruments which we are offering in the succeeding pages are all made with the D'Arsonval movement, the utmost care used in the construction to secure such indispensable qualities as the dead-beat feature, a strong and uniform magnetic field, and, in case of the galvanometer in particular, uniform scale, since this instrument employs a printed rather than a hand-drawn scale.

In the construction of the various ranges we use a drop forge magnet, made from the best magnet steel circular in form, which gives the strongest and most uniform field. Scale of such proportion that one division represents approximately one milvolt. Jewel bearings, hardened-steel pivots, hand-calibrated and hand-drawn scale, except in the case of Galvanometer **No. 93–195,** on which we use a printed scale. All types of instruments are provided with a zero adjustment accessible on the top of the instrument, without removing the case. Mounting finely finished, mahogany base with cap of punched metal, amber finish. For convenience in the use of these instruments in the laboratory, we have adapted the binding posts **Nos. 90–316A to E** previously listed, on account of the readiness with which this post will securely grip any size wire without danger of being accidentally loosened and causing delays in the work.

93–195 **D'ARSONVAL GALVANOMETER.** This instrument is the same as the ammeters, voltmeters and voltammeters listed below, except that no shunts and resistances are provided and a printed scale is employed. Each division of the scale represents approximately one milvolt, but we do not claim this to be an accurate milvoltmeter. The instrument is sufficiently sensitive for general laboratory practice in students' Wheatstone bridge experiments, polarization of cells, and the general range of students' laboratory work where a zero center, quick reading instrument is desired..... **$16.50**

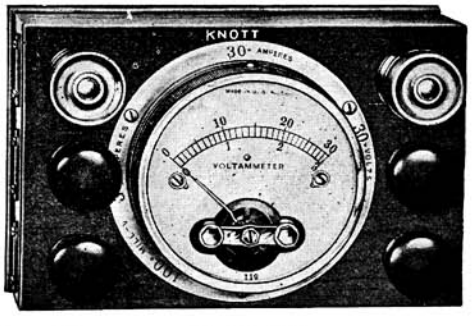
93–525 **D'ARSONVAL LABORATORY AMMETER, DOUBLE SCALE, 0-25 amperes** (in black) and **0-5 amperes** (in red). This instrument is fundamentally the same as **No. 93–195,** except that it is provided with shunts in order to transform the galvanometer or milvoltmeter into an ammeter. Each instrument is carefully calibrated and the scale drawn in by hand..... **18.00**

93–535 **D'ARSONVAL LABORATORY VOLTMETER, DOUBLE SCALE, 0–120 volts, 2-volt divisions** (in black) and **0–12 volts, 1/5-volt divisions** (in red). This instrument is fundamentally the same as **No. 93–195** except that it is provided with resistances to transform the galvanometer into a voltmeter..... **18.00**

93–650 **VOLT-AMMETER, 10 volts and 10 amperes,** zero at the center of scale. This instrument has same refinements as above, but designed to serve both as a voltmeter and an ammeter..... **20.00**

93–670 **——, 120 volts and 15 amperes,** zero at the center of scale..... **24.50**

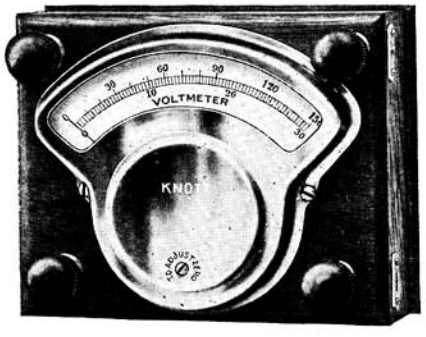
93–635 **MULTIPLE RANGE PORTABLE D. C. ROTARY METER. Five accurate electrical measuring instruments in one** — a milvoltmeter, 0–90 milvolts; a voltmeter, 0–15 volts; a voltmeter, 0–150 volts; an ammeter, 0–3 amperes; and an ammeter, 0–30 amperes. Fixed in a polished mahogany base, 4½×3×1½ inches, is a set of segments each segment being properly connected to a shunt or resistance spool, also set in the base and connected with a terminal binding post. A D'Arsonval milvoltmeter is pivoted in the center of the segments and as it is rotated a terminal at its base comes in contact with the copper segments, thus connecting the proper shunt or resistance to the rotating instrument. A fixed index finger on the side of the knurled meter case shows the position of this terminal, and suitable markers on the metal ring around the rotating member and attached to the base show the position of the segments.



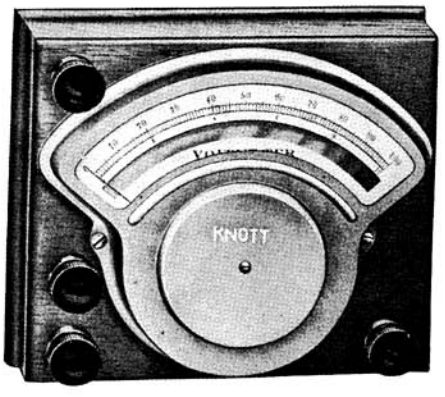
No. 93–635

The instrument is simple but rugged in construction. Readings accurate to ½ of one per cent..... **28.00**

PORTABLE ELECTRIC MEASURING INSTRUMENTS



No. 93–688



No. 93–728

These meters answer the demand for a small, portable meter that is accurate, sensitive and moderate in price. The magnet used is a high-grade drop forging properly aged and capable of giving excellent results indefinitely. Jeweled bearings, hardened steel pivots. Zero adjustment, accessible on the top of the instrument. Polished mahogany base, 5¼×4¼ inches. Top of brass, fan shaped, black enamel finish.

DIRECT CURRENT

93–680	PORTABLE D. C. VOLTMETER, 0–10 volts	$16.50
93–682	——, 0–30 volts	16.75
93–684	——, 0–150 volts	20.00
93–686	PORTABLE D. C. VOLTMETER, DOUBLE SCALE, 0–3 and 0–30 volts	20.00
93–688	——, 0–15 and 0–150 volts	23.50
93–690	PORTABLE D. C. AMMETER, 0–100 milamperes	16.50
93–692	——, 0–10 amperes	16.75
93–694	——, 0–25 amperes	19.00

ALTERNATING CURRENT

93–701	PORTABLE A. C. VOLTMETER, 0–15 volts	$20.00
93–703	——, 0–150 volts	25.00
93–705	PORTABLE A. C. VOLTMETER, DOUBLE SCALE, 0–15 and 0–150 volts	31.50
93–707	PORTABLE A. C. AMMETER, 0–5 amperes	20.00
93–709	——, 0–15 amperes	20.00
93–711	——, 0–50 amperes	22.50

PORTABLE PRECISION METERS

These meters are larger than types listed above. They are fitted with an unusually large drop-forged magnet carefully aged and treated, pole faces accurately ground and core iron of special analysis with a patented adjustable feature to locate accurately the position of the core. They are especially dead-beat and accurate, the scale fitted with a mirror for precision work. Nothing has been spared to make these meters the most accurate and dependable instruments on the market.

Polished mahogany base, 5⅝×5 inches. Top of brass, fan shaped, black amber finish.

DIRECT CURRENT

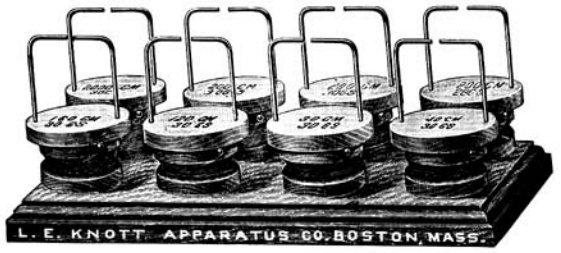
93–722	PORTABLE D. C. PRECISION VOLTMETER, 0-3 volts	$55.00
93–724	——, 0–15 volts	55.00
93–726	——, 0–150 volts	55.00
93–728	PORTABLE D. C. PRECISION VOLTMETER, DOUBLE SCALE, 0–15 and 0–150 volts	67.50
93–730	PORTABLE D. C. PRECISION AMMETER, 0–100 milamperes	55.00
93–732	——, 0–10 amperes	55.00
93–734	——, 0–25 amperes	55.00

ALTERNATING CURRENT

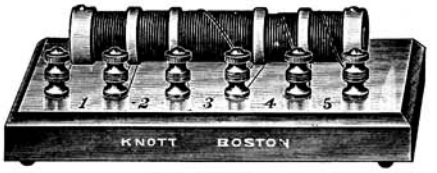
93–741	PORTABLE A. C. PRECISION VOLTMETER, 0–150 volts	$55.00
93–743	——, DOUBLE SCALE, 0–150 and 0–300 volts	67.50
93–747	PORTABLE A. C. PRECISION AMMETER, 0–10 amperes	55.00
93–749	——, 0–25 amperes	55.00

ELECTRICAL RESISTANCE APPARATUS

RESISTANCE COILS



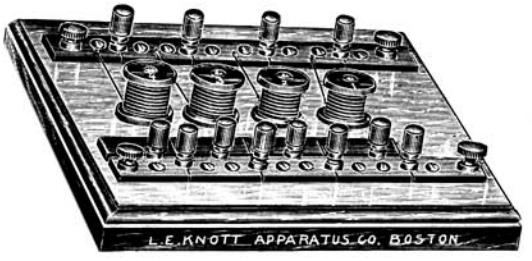
No. 94–70



No. 94–80

No. 94–60

No. 94–30



No. 94–90

94–20 **ONE-OHM RESISTANCE** (see Millikan, Gale & Bishop, Exp. 33) **$0.40**

94–21 **THOUSAND-OHM RESISTANCE** (see Millikan, Gale & Bishop, Exps. 31 and 32) ..... **.65**

94–30 **SPOOL RESISTANCES,** guaranteed accuracy of 1/5 of one per cent.

	a	b	c	d	e	f	g	h	i
Resistance, ohms	1	2	3	4	10	20	30	40	50
Each	**$1.00**	**1.00**	**1.00**	**1.10**	**1.25**	**1.40**	**1.40**	**1.45**	**1.50**
	j	k	l	m	n	o	p	q	
Resistance, ohms	100	200	300	400	1000	2000	3000	4000	
Each	**$1.75**	**2.00**	**2.15**	**2.30**	**2.50**	**2.65**	**2.80**	**3.00**	

94–60 **TEMPERATURE COIL** for study of effects of temperature upon resistance. Consists of a coil of high resistance wire wound on a molded porcelain spool designed to fit the dippers of Hypsometers **Nos. 60–350** and **60–365.** Ends of coil attached to binding posts **2.25**

94–61 **TEMPERATURE COIL** (see National Physics Direction Sheets, Exp. E081) ..... **.15**

94–70 **HYDE FORM RESISTANCE SPOOLS** for use in determining resistance and in formulating laws of resistance in wires. The base has eight dowel pins on which are supported spools wound with wires of different lengths, diameters and materials, to secure the following combinations:

2 spools (200 cms. No. 30 German Silver Wire) same material, diameter and length.
2 spools (200 cms. No. 30 and 200 cms. No. 28 German Silver Wire) same material and length, but different diameters.
2 spools (40 and 80 cms. No. 30 German Silver Wire) same material and diameter, but one double the length of the other.
2 spools (120 and 160 cms. No. 30 German Silver Wire) which in addition to spools above will allow comparison of same diameter and material, but of lengths as 1:2:3:4:5.
1 spool (2000 cms. No. 30 Copper Wire) same diameter, different material from one of the above (200 cms. No. 30 German Silver) and ten times the length.
Leads are attached to each spool for connecting to the Wheatstone bridge. These leads are attached so that there is little or no danger of the ends of the wires becoming detached from the leads **5.50**

94–80 **RESISTANCE SPOOLS,** five coils mounted as illustrated, the ends connected to binding posts. Coils as follows: 10 meters Nos. 22 and 28 Copper Wire, 20 meters Nos. 22 and 28 Copper Wire, and 10 meters No. 22 German Silver Wire **5.00**

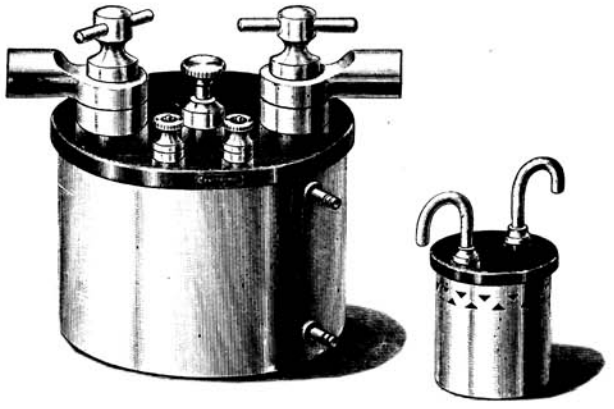
94–90 **ANDREWS' RESISTANCE BOARD.** Four coils of wire: 300 cms. No. 36 Copper, 600 cms. No. 36 Copper, 300 cms. No. 30 Copper, and 300 cms. No. 30 German Silver Wire, wound on bobbins and connected to brass blocks so that by means of tapered plugs, combinations in series and parallel of any one or more of the coils can be secured by properly placing the plugs in their tapered holes .. **10.50**

94–95 **CULLER'S DOUBLE RHEOCHORD** (see Culler's "Laboratory Manual of Physics," Exp. XLVC) Per pair **13.50**

94–97 **FULLER & BROWNLEE'S RHEOCHORD BOARD** (see Fuller & Brownlee, Exp. 73) **7.00**

94–98 **RHEOCHORD BOARD** (see Millikan, Gale & Bishop, Exps. 32 and 35) **7.00**

No. 94–100



Nos. 94–115 to 94–117

94–100 STANDARD RESISTANCES. The coil illustrated has been designed for use whenever the highest accuracy is not required, and the inconvenience attending the use of an oil bath can therefore be avoided. Though not intended as the highest standards, accuracy and compactness make these coils convenient for many purposes. The winding is a matter of great care; the wire used is manganin, and the core on which the coil is wound is of brass. This core is open at each end, giving ventilation as well as preventing changing of temperature; also permitting the introduction of a thermometer into the interior. The winding is arranged in a thin layer on the core and insulated with only sufficient wax to prevent access of the air to the wire.

The case is of brass; the terminals are heavy copper rods giving ample conductivity and contact surface. The lower ends of these rods are arranged to dip into mercury cups, while the upper ends are equipped with large binding posts screwing into the copper bars and bearing against lugs which give ample clamping surface.

These coils are furnished in four different sizes as listed below. They are accurately adjusted to 1/10 of one per cent. With each coil a certificate of accuracy giving the date, temperature, and precise value of the resistance at the final test is included.

	a	b	c	d
Capacity, ohms	1	10	100	1000
Each	**$17.00**	**18.15**	**19.25**	**23.20**

94–115 STANDARD RESISTANCES, universally accepted for work on high precision. The resistance material is manganin, selected not only for its approved permanence and low temperature resistance coefficient, but also for its small thermo-electro-motive force against copper. The external case is not in connection with the winding and furnishes merely a mechanical support and protection. The standard may be immersed in oil so that the coil is completely submerged, and the case, bobbin, and winding are so arranged that the oil has access to all parts of the coil, making it possible to ascertain or control its temperature with certainty. An opening through the ebonite top permits the insertion of a thermometer into the interior. Case and terminals are nickel-plated to prevent corrosion. Every operation of the construction of these standards, winding, aging, and adjustment, is most carefully carried out. Our standards will therefore be found not merely accurate in adjustment but also permanent in calibration. Each coil is adjusted to 1/100 of one per cent of the value of our copies of the United States Standard. With each resistance sent out is a certificate of accuracy for each coil.

	a	b	c	d	e
Capacity, ohms	1/10	1	10	100	1000
Each	**$63.00**	**64.00**	**65.00**	**67.50**	**70.00**

94–117 STANDARD RESISTANCES, same accuracy and general structure as above, but arranged for air cooling only.

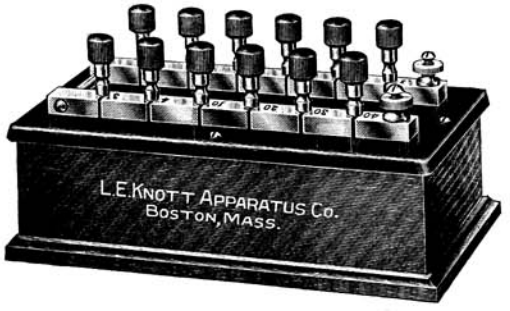
	a	b	c	d
Capacity, ohms	1	10	100	1000
Each	**$31.00**	**32.00**	**34.00**	**37.50**

94–125 SINGLE-COIL TENTH MEGOHM. The coil is wound non-inductively with our special " B " high resistance wire, which we consider for purposes of a megohm box superior to manganin as used in all of our low-range boxes. Each coil is thoroughly protected from moisture by wax and insulating covering, which also seems to give to each unit ability to withstand mechanical strains. This unit is mounted in a cylindrical brass case with raised terminals, thermometer hole, and offered in form as illustrated.

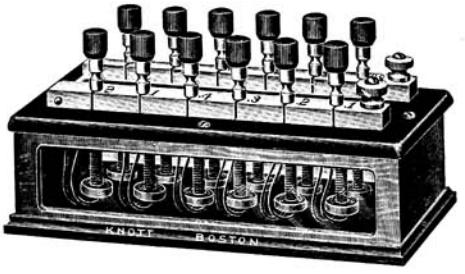
Tenth Megohm Coil as illustrated **55.00**

No. 94–125

RESISTANCE BOXES



Nos. 94–152 to 94–155



No. 94–160

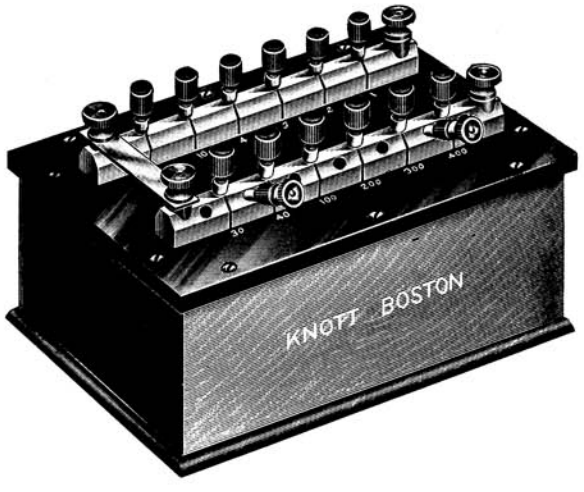
94–150 **SCHOOL RESISTANCE BOX, range 1 to 20 ohms,** guaranteed accuracy of ½ of one per cent... **$7.15**

94–152 **SCHOOL RESISTANCE BOX, range 1/10 to 111 ohms,** guaranteed accuracy of 1/5 of one per cent. **14.50**

94–155 ——, same as above, but with certificate from our electrical laboratory..... **17.50**

94–157 **SCHOOL RESISTANCE BOX, range 1 to 1,110 ohms,** guaranteed accuracy 1/5 of one per cent ... **20.00**

94–160 **SCHOOL DEMONSTRATION RESISTANCE BOX,** same as **No. 94–152,** but with glass front and back, permitting view of coils and various coil connections..... **17.50**

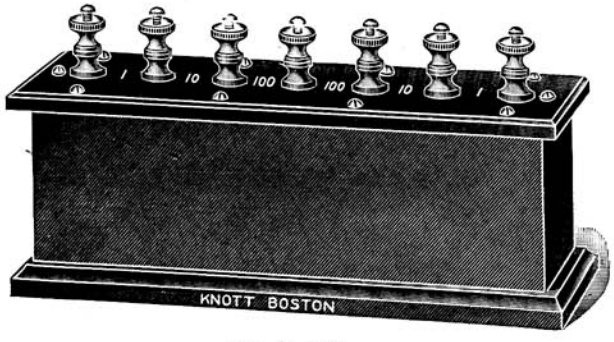


No. 94–190

94–190 **TRAVELING PLUG RESISTANCE BOX, range 1 to 1,110 ohms.** This box is provided with extra heavy brass blocks and reinforced ebonite top. Contains 12 coils ranging from 1 to 400 ohms, with total resistance of 1,110 ohms. The usefulness of this box is increased by the addition of two traveling plugs facilitating its use in the comparison of electro-motive force of batteries, and other tests. Guaranteed accuracy of 1/5 to 1/10 of one per cent..... **52.00**

94–195 **——, range 1 to 11,110 ohms.** This box is similar to the above but constructed for greater range. Contains 16 coils ranging from 1 to 4000 ohms with total resistance of 11,110 ohms. Guaranteed accuracy of 1/5 to 1/10 of one per cent..... **60.00**

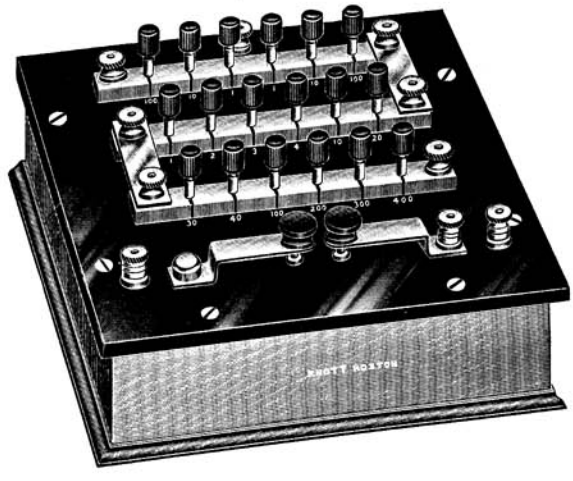
COMBINED BRIDGE AND RESISTANCE BOXES



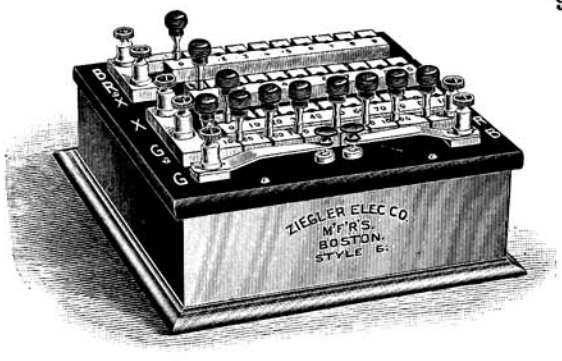
No. 94–250

94–250 RATIO BOX. In Wheatstone bridge work it is essential that easily accessible ratio arms be provided. This box has been designed for this particular purpose. It contains six coils as follows: 1, 10, 100, 100, 10, and 1 ohms, which will give nine different working ratios. Each coil is guaranteed accurate to 1/10 of one per cent. It may therefore be seen that with this accuracy the ratio box may be used as a standard resistance of 222 ohms capacity **$22.00**

94–270 IMPROVED COMBINED BRIDGE AND RESISTANCE BOX. Bridge coils are 1, 10, 100, 100, 10, and 1 ohms. Resistances range from 1 to 400 ohms. Total resistance 1,110 ohms. Total range of measurements from .01 ohm to 111,000 ohms. Guaranteed accuracy 1/5 to 1/10 of one per cent..... **55.00**



No. 94–270

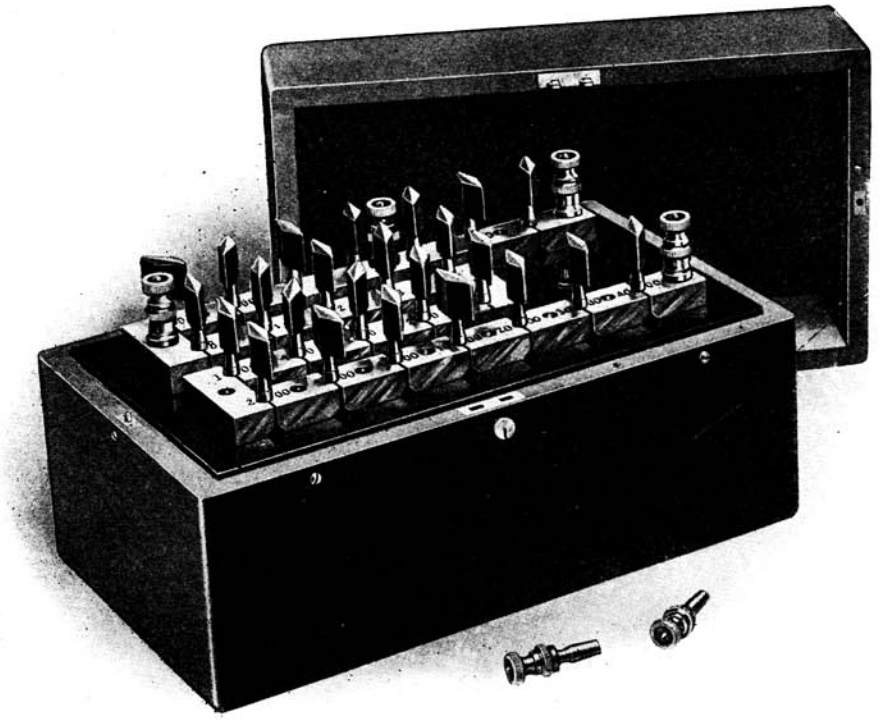


No. 94–280

94–280 ZIEGLER BRIDGE AND RESISTANCE BOX. This box has been especially designed to meet the constant demands for a reliable and conveniently arranged combined box giving a wide range, yet one which can be furnished at a price within the appropriation of most schools.

The first row of the resistance box contains nine 1/10-ohm coils; the second ten 1-ohm coils; the third ten 10-ohm coils. The total range of measurement, therefore, is from .001 to 11,090 ohms. Separate keys properly connected for battery and galvanometer are mounted as illustrated. Coil accuracy guaranteed to 1/10 of one per cent. **85.00**

PRECISION RESISTANCE BOX AND BRIDGE



No. 94–300

94–300 STANDARD PRECISION RESISTANCE BOX, designed to give the highest degree of precision of which the plug contact form of Wheatstone bridge is capable; constructed to furnish the best that modern research has produced.

Range. The one-ohm ratio coil can be thrown into either arm desired by means of one of the traveling plugs supplied with the box. The range of the bridge is, therefore, from .001 to 11,110,000 ohms.

Resistance Arms—			
1	10	100	1000 ohms
2	20	200	2000 ohms
3	30	300	3000 ohms
4	40	400	4000 ohms
Bridge Arms—			
1	10	100	1000 ohms
	10	100	1000 ohms
Total			13,331 ohms

Accuracy. All the features tending to give permanency of calibration as well as accuracy have been studied in every detail. The coils in the ratio arms are adjusted to 1/10 of one per cent.; those in the ratio arms to 1/20 of one per cent. With a proper handling of this box, results may be secured limited only by the inherent capabilities of the plug contact form.

SPECIAL FEATURES

Coils of manganin wire, aged by our special process, wound on hollow brass bobbins, securing perfect insulation and greater carrying capacity, individually tested, and attached by special arms, permitting new coils to be furnished and attached by user.

The **Insulation** is of the very highest quality, interior of box practically moisture proof to insure permanency of insulation.

Connecting Blocks of unusually large size, of ample clearance and special provision for cleaning.

Traveling Plugs — two furnished with each box.

Coil Plugs, rubber handles, diamond form; tapers designed for constant use without contact error.

Grid Support, on interior of box to prevent springing of top by excess plug pressure.

Cover. Dust-tight, provided with each box to insure life of rubber top.

PRICE, $220.00

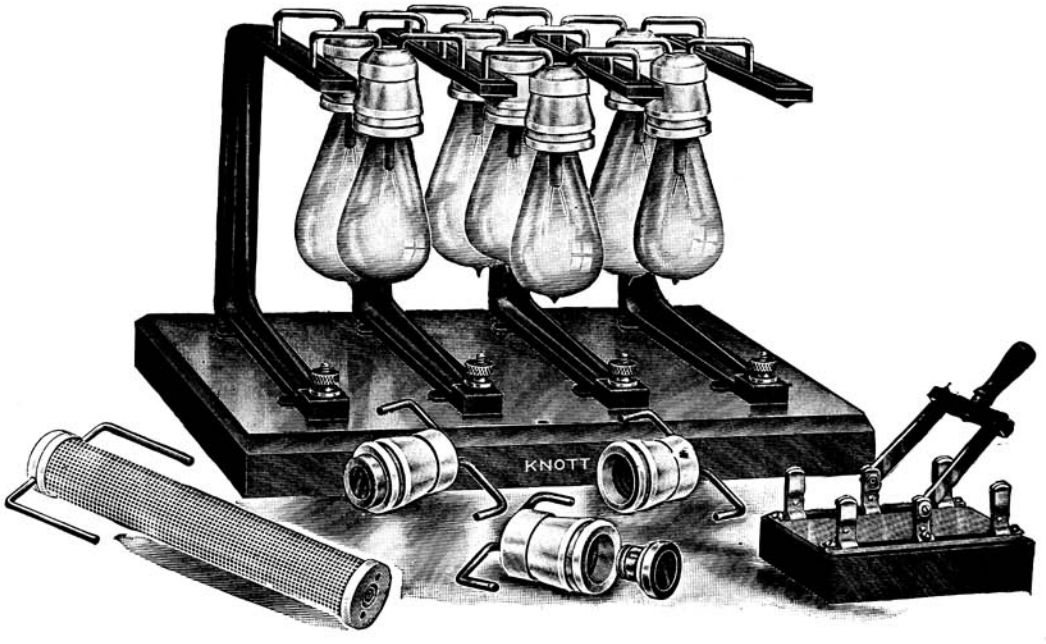
UNIVERSAL LECTURE TABLE RHEOSTAT AND RESISTANCE FRAME

The apparatus comprises a finished slate base carrying four metal brackets adapted to hold lamps, units, etc., in circuit without the necessity of clamps and screws. Special porcelain sockets having rigid metal terminals are provided for holding lamps, fuses, and like attachments normally fitted with the ordinary Edison Base. The Harcourt Resistance Units are complete in themselves and require no sockets.

The apparatus being constructed entirely of fireproof material conforms to the Rules of the National Board of Fire Underwriters and will be found of unusual merit in both elementary and the more elaborate experimental work.

Lamps, resistance units, bridge and fuse plugs are in circuit when they bridge across adjacent brackets with their terminals in the troughs.

A wide range of ampere values may be secured by using the resistances — lamps or resistance units, in series or multiple connections. A still greater range is possible by the series-multiple arrangement. Our **No. 94–385** Special Bridges have a negligible resistance and are used for facilitating connections.



A Group Cut Illustrating the Following Numbers

94–350 **UNIVERSAL LAMP RHEOSTAT (Resistance Frame with 110-Volt Lamps) range 0.2 to 6.00 amperes.** Includes 7 **No. 94–365** Mounted Sockets, 2 16-C. P. Lamps, and 5 32-C. P. Lamps.... **$32.00**

RESISTANCE FRAME AND 110-VOLT RESISTANCE UNITS

94–353 **UNIVERSAL LECTURE TABLE RHEOSTAT, range 0.24 to 7.48 amperes by 0.6 ampere steps.** Includes 2 **No. 94–375,** 1 **No. 94–376** and 2 **No. 94–377** Resistance Units and Resistance Frame.. **$37.75**

94–356 ——, **range 0.24 to 18 amperes by 0.6 ampere steps.** Includes 3 **No. 94–375,** 1 **No. 94–376,** 2 **No. 94–377** and 2 **No. 94–378** Resistance Units and Resistance Frame..... **49.50**

94–358 ——, **range 0.24 to 40 amperes by 0.6 ampere steps.** Includes 3 **No. 94–375,** 1 **No. 94–376,** 3 **No. 94–377** and 6 **No. 94–378** Resistance Units and Resistance Frame..... **67.50**

94–360 **MOUNTED D. P. D. T. KNIFE SWITCH.** Capacity, 50 amperes at 250 volts. Slate base mounted on heavy slate sub-base..... **5.50**

94–365 **RIGID ARM PORCELAIN MOUNTED SOCKET** for holding lamps, bridge and fuse plugs. ach, **1.80.** Six **10.25**

94–375 **HARCOURT RESISTANCE UNIT,** 6 inches long, 0.6 ampere capacity..... **3.90**

94–376 **HARCOURT RESISTANCE UNIT,** 8 inches long, 1.2 ampere capacity..... **4.00**

94–377 **HARCOURT RESISTANCE UNIT,** 10 inches long, 2.5 ampere capacity..... **4.15**

94–378 **HARCOURT RESISTANCE UNIT,** 12 inches long, 5 ampere capacity..... **4.25**

94–380 **FUSE PLUG, EDISON BASE,** carrying capacity 3 amperes..... **.25**

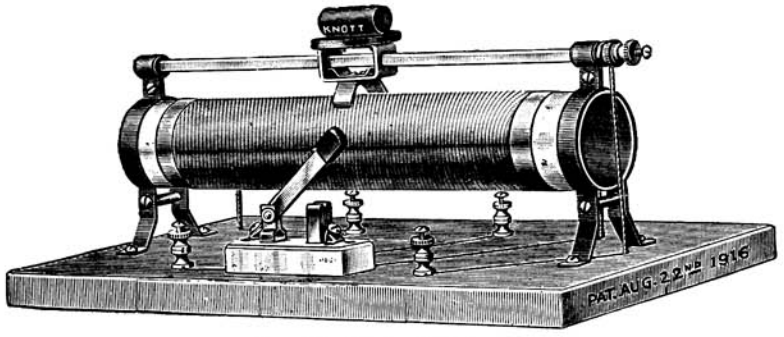
94–385 **SPECIAL BRIDGE**..... **.60**

Send for Special Descriptive Circular

94–390 **LAMP BOARD WITH 32 C. P. LAMPS** (see Fuller & Brownlee, Exp. 77)..... **19.50**

SLIDE RHEOSTATS

Connection in Series with the Load or as a Shunt Across the Line



Nos. 94–402 to 94–406

The popularity of slide rheostats is the natural result of the need for such instruments. Their utility for the many electrical experiments was apparent from the first introduction of the Ruhrstrat types which we formerly listed for duty-free importation. These types of rheostats have been greatly improved in this country. We can now furnish a system of wiring whereby a slide resistance may be **connected in series with the load or as a shunt across the line,** the change being made simply by closing a single-throw switch. By means of the slider, the resistance can be varied from zero to the maximum capacity.

Small Voltages and Currents. When the rheostat is connected in series with the load, this variation of the resistance produces a variation in the voltage and current, the minimum limited by the ratio of the load resistance to the total resistance of the circuit. One can then obtain very small voltages and currents.

Entire Range of Voltage and Current. By closing the single throw switch, thereby shunting the rheostat across the line, the voltage may be varied from zero to a maximum amount which is the same as the minimum of the series connection. One secures, then, the full value of the rheostat and can run the entire range of voltage and current.

These rheostats are made to endure even under abuse. Oxidized resistance wire is wound on an enameled metal tube which provides for the more rapid dissipation of heat than the old slate form. A slider provides positive contact. Rating in maximum current and voltage stamped in plain figures on slider. Base of asbestos slate.

When Ordering

consider only the available voltage and the maximum current required by the load.

Current rating is for continuous service with moderate temperature rise. Overloads of 50 per cent. are permissible on intermitted service.

94–402 SLIDE RHEOSTATS, maximum voltage of 110; length of tube, 12 inches.

	a	b	c
Maximum current, amperes	2.5	2.0	1.5
Approximate resistance, ohms	65	90	175
Price, each	**$13.50**	**13.50**	**13.50**

94–404 ——, length of tube, 20 inches.

	a	b
Maximum current, amperes	4	3
Approximate resistance, ohms	35	75
Price, each	**$16.00**	**16.00**

94–406 SLIDE RHEOSTAT, maximum voltage of 220; length of tube, 20 inches. Maximum current, 2 amperes; approximate resistance, 160 ohms . . . . . Each **$16.00**

Nos. 94–402a, 94–404a and **94–406a** are designed to give the maximum capacity within the limits imposed by voltage, length of tube and a moderate temperature rise and, therefore, have the lowest resistance. These rheostats should be ordered unless it is absolutely certain that the higher resistances are required.

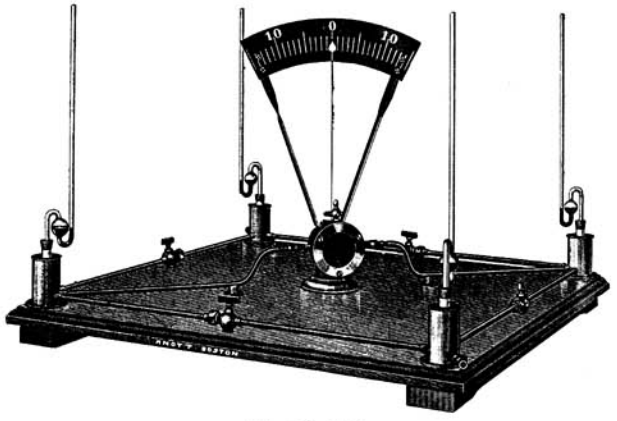
94–408 SLIDE RHEOSTATS, DOUBLE. Two tubes in parallel on one base.

	a	b	c
Maximum voltage	110	110	220
Maximum current, amperes	5	8	4
Approximate resistance, ohms	32	17	80
Length of tube, inches	12	20	20
Price, each	**$30.00**	**35.00**	**35.00**

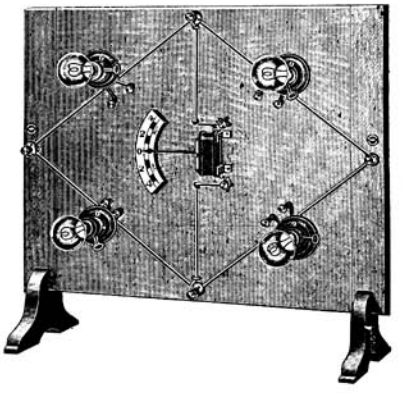
WHEATSTONE BRIDGES

DEMONSTRATION WHEATSTONE BRIDGES

Too little attention has been given in schools to a thorough understanding of that basic principle, fall of potential, fundamental to Wheatstone bridge work. A student's incomplete understanding of fall of potential makes it difficult for him to understand what he is striving to obtain when he uses a Wheatstone's bridge. This incomplete understanding is due, perhaps, to the word-of-mouth descriptions and the lack of adequate illustrative demonstrative apparatus. To picture for him the actual fall of potential, we heartily recommend the following apparatus. The analogy between hydraulic pressure and electromotive force is often resorted to by teachers, yet the analogy has never been worked out instrumentally except in the following apparatus.



No. 94–455
(Approximately 1/12 Size)

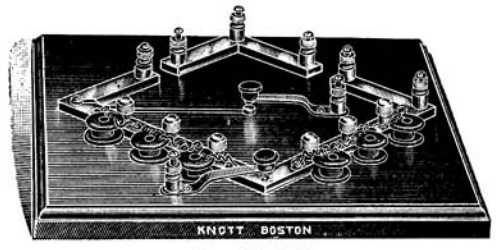


No. 94–460
(Approximately 1/10 Size)

94–455 HYDRODYNAMIC WHEATSTONE BRIDGE for a study of the principles involved by measurements of resistances by the Wheatstone's bridge method, using fall of hydraulic pressure as an analogy to electromotive force. On a polished wooden base board is mounted a system of tubes connected to form a Wheatstone's diagram. In the "arms" are reducing valves analogous to resistances. Pressures in the various arms are indicated by the manometers. In the "bridge" is a pressure indicator analogous to the galvanometer.

By connecting to one of the nipples noted in the illustration and allowing a flow of water through the apparatus, the fall of pressure through the different arms may readily be noted. By regulating the reducing valves in these arms, a balance may be secured when no indications of pressure can be noted in the "bridge." The pressures in the arms will then be noted in the manometer. This apparatus is large in size (the base measuring 24×30 inches). Results are positive and can be seen clearly by all even in a large lecture room. Its teaching value in making clear fall of potential fully justifies its purchase **$83.00**

94–460 DEMONSTRATION WHEATSTONE BRIDGE for a study of fall of potential and demonstration of the principle of the Wheatstone bridge. This apparatus was designed for use on the lecture table, which accounts for its generous proportions. Please note that each arm of the bridge has an incandescent lamp inserted in it, so that whether current goes through that arm or not becomes evident instantly. A galvanometer is provided as part of the outfit. As a companion instrument to **No. 94–455** Hydrodynamic Wheatstone bridge, demonstrations of fall of potential as utilized in the Wheatstone bridge are simply and clearly made. Complete as illustrated with incandescent lamps **65.00**



No. 94–470

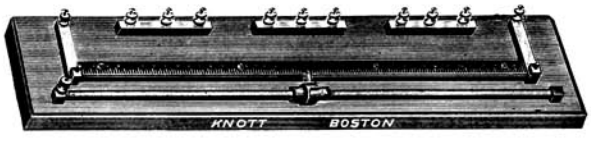
94–470 DEMONSTRATION WHEATSTONE BRIDGE, Diamond Form for practical application of Wheatstone diagram in determining resistance. As will be noted from the illustration, all connections and coils are mounted on a base according to the Wheatstone diagram as found in standard text books. In the "ratio arms" are coils of 1, 10 and 100 ohms. The "balance arms" are provided with gaps each with non-detachable binding posts, one pair for the "known" and one pair for the "unknown" resistance. Binding posts and a key are provided for the battery and galvanometer circuits **13.00**

WHEATSTONE BRIDGES

No. 94–480

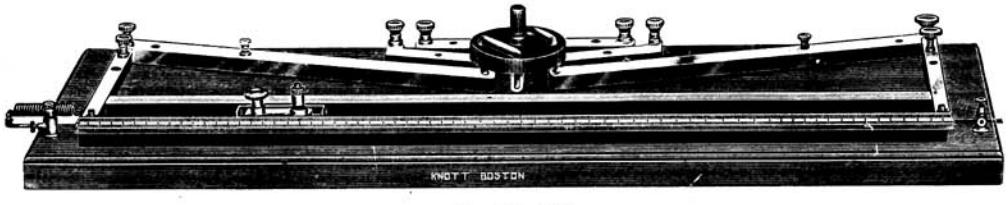
94–480 WHEATSTONE STANDARD SLIDE WIRE BRIDGE, one meter long. Copper and brass leads of ample cross section, non-detachable binding posts, high resistance wire, improved positive sliding contact key, mounted with scale on polished hardwood base..... **$6.25**

94–482 WHEATSTONE BRIDGE (see Millikan, Gale & Bishop, Exps. 32 and 33) **4.25**



No. 94–495

94–495 WHEATSTONE CAREY-FOSTER BRIDGE, half-meter long. Extra heavy brass leads, non-detachable binding posts, improved knife edge sliding contact key, mounted with improved scale on highly polished base. Superior construction and finish throughout..... **19.50**



No. 94–525

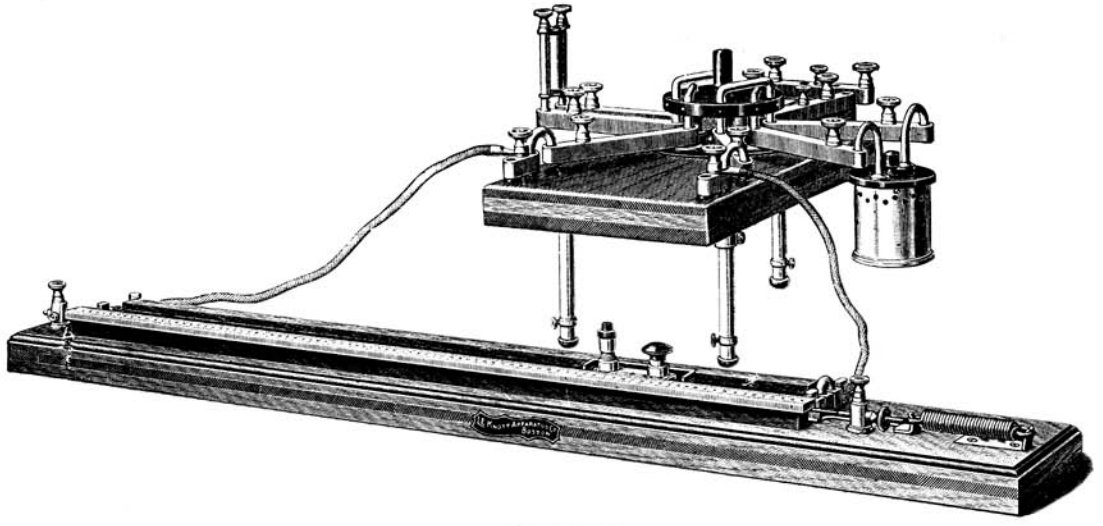
94–525 THE UNIVERSITY REVERSIBLE SLIDE WIRE METER BRIDGE for measuring resistances with low E. M. F. where the plug form of resistance box would be useless. With both mercury cup and binding post contact, Lattimer-Clark commutator, tension spring for bridge wire, contact slide with rack and pinion, and fine adjustment with push button locking device for holding the contact at any desired point. Four gaps are provided for ratio coils and extension coils which are also available for inserting coils in the conventional Wheatstone bridge arrangement. The commutator may be removed, leaving available two extra gaps which may be required in special work. Connecting bars are of extra large cross section. Base is of three-ply mahogany, oil and pumice finish..... **150.00**

No. 94 – 535

UNIVERSAL SLIDE BRIDGE

(Improved Carey-Foster Bridge)

This bridge combines apparatus for resistance measurements of the highest degree of accuracy with special means for making approximate determinations with speed and convenience. It covers all ranges of measurement from the resistance of a short copper bar of large cross section, to the highest that can be reached by the Wheatstone principle.



No. 94–535

Uses. This bridge was originally designed for modern special methods such as the Carey-Foster balance and its recent modifications. It is, therefore, a Carey-Foster bridge. It was found, however, that certain modifications could be made so that the bridge might be used for quick approximations, and this without sacrifice of accuracy and convenience.

It is appropriate for practically all measurements for which the Wheatstone bridge in any form can be used. It is particularly adapted for:

1. Measurements of greater accuracy than the plug form of bridge and box is capable of, such as comparison of standards, testing of resistance boxes, accurate adjustment of coils, determination of temperature, resistance coefficients, etc. A precision of one part in 100,000, or even better, can be readily obtained.
2. Measurements of very low resistances, such as plug contacts for which purpose it will be found preferable to the Thompson double bridge.
3. Measurements of special kinds. It can be used to give the error of a coil in millimeters of wire to be cut off or added, or to give the errors of a resistance box as percentages.

The bridge consists of two parts — the connector board or coil holder and the slide.

Commutator. The commutator and its relation to the connector bars carries out the Carey-Foster equations with absolute accuracy. This feature eliminates all thermo-electric errors and also the errors due to the resistance of the bridge.

The commutator is pivoted and its swing of 90 degrees is limited by stops at each end, so that its operation does not distract the operator from his readings.

Insulation. The insulation requirements have been carefully studied. The ebonite insulation between the connector bars is one feature of our design. It insures accurate measurement of high resistances.

Sliding Contact. The slider combines in small compass the moving contact, coarse and fine adjustments, tapping or contact key, contact locking device and vernier. Every refinement has been added, regardless of cost, to give a perfect attachment.

Slide Wire. We employ a slide wire of uniform cross section and having a temperature coefficient so low that it can be considered negligible except for measurements of greatest accuracy. The slide wire is held by a special device always under a uniform spring tension.

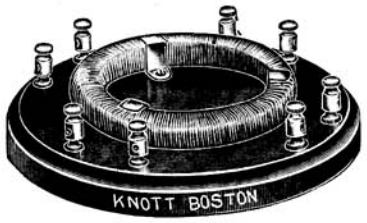
Fixed Contacts. In addition to mercury cups of liberal dimensions, we furnish large binding posts which will be found more convenient when extreme precision is not required.

Materials. The bases are of 3-ply mahogany, dull finish. Connector bars are of solid copper, of liberal cross section. All brass work and copper bars are heavily lacquered, a finish which we have found vastly superior to the nickel-plate finish as a protection against mercury.

In our own laboratory we have for years made extensive use of the Carey-Foster bridge. Many improvements have been suggested during this experience and they have been embodied in the instrument described above.

Without resistance coils, but otherwise complete as illustrated with calibrated ½-inch copper leads. . . . **$325.00**

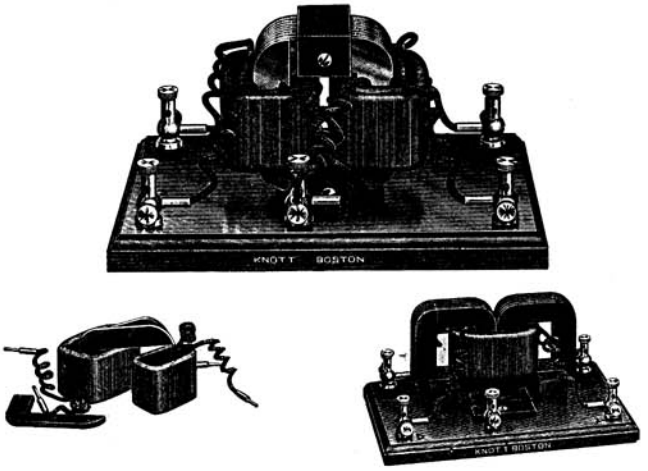
TRANSFORMING AND INTERRUPTIVE APPARATUS



No. 95–10

95–10 FARADAY'S RING AND DEMONSTRATION TRANSFORMER for study of self and secondary induction as applied to step-up and step-down transformers. A closed magnetic circuit within a coil of wire which is tapped and brought to binding posts dividing itself into four coils of equal number of turns. The ratios of transformations are as 1:1, 1:2, 1:3, 1:4, 2:1, 2:3, 3:2, 3:1 and 4:1. Mounted on finished hardwood base..... **$6.25**

95–15 INDUCTION COIL (see Millikan, Gale & Bishop, Exp. 36). Simple coil of wire on brass spool..... **.95**



No. 95–30

95–30 EDUCATIONAL DISSECTIBLE WORKING TRANSFORMER for use on any alternating-current circuit up to 115 volts. The distinctive advantage of this model over similar designs on the market is that all parts are dissectible and can be used in a multitude of ways to teach the principles and laws of self and secondary induction, electro-magnetism, etc. As will be noted in the illustration, the **core** is made up of punchings put together in small units for convenient handling. The **primary and secondary coils** are form-wound, taped, and supplied with flexible leads. These parts can readily be assembled to demonstrate various types of transformers — Faraday's ring, auto-transformer of the shell type, auto-transformer of the block or iron-clad type, primary and secondary transformer of the shell type, primary and secondary transformer of the block type, etc.

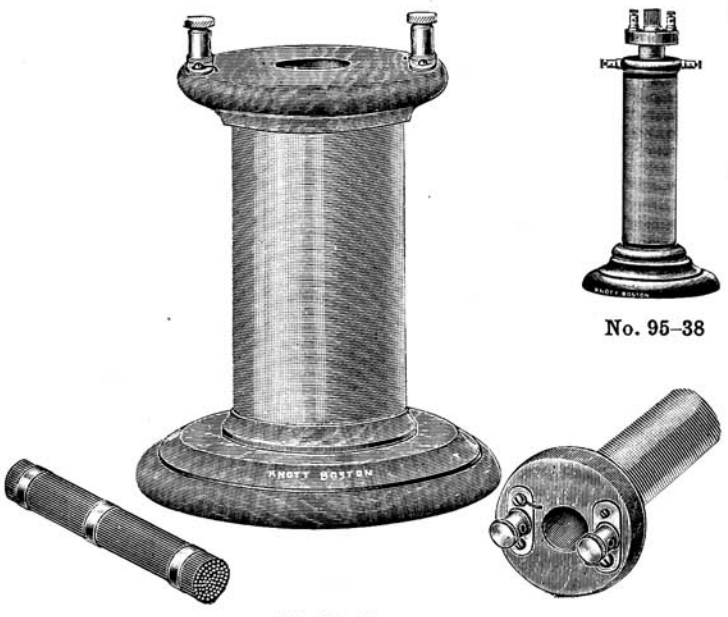
The **ratios of the primary to the secondary coils** are such that a great variety of transformations may be obtained. If the primary circuit is 110 volts, the voltages drawn from the secondary in various combinations (fully illustrated by diagrams furnished with each instrument) are 1, 15, 30, 60, 220, 235 and 255 volts. Other ranges are obtained on other voltages in the primary.

Many interesting and instructive experiments are shown in detailed diagrams in a special descriptive circular which may be obtained on request. Mounted on polished hardwood base with six double binding posts which simplify connections of primary and secondary coils..... **19.50**

95–33 LABORATORY TRANSFORMER, 100-watt, for use on 110-volt, 60-cycle circuit, to operate small motors, light small lamps, and to operate small induction coils, etc., that are usually operated on battery current. Secondary voltages range from 2 to 28 volts by 2-volt steps. The constant voltages are 4, 6, 8, 10, 14 and 18, and any of these voltages can be used simultaneously. Length, 5 inches; width, 4 inches; height, 3¾ inches. With connecting plug and 7 feet of connecting cord..... **9.50**

No. 95–33

PRIMARY AND SECONDARY COILS



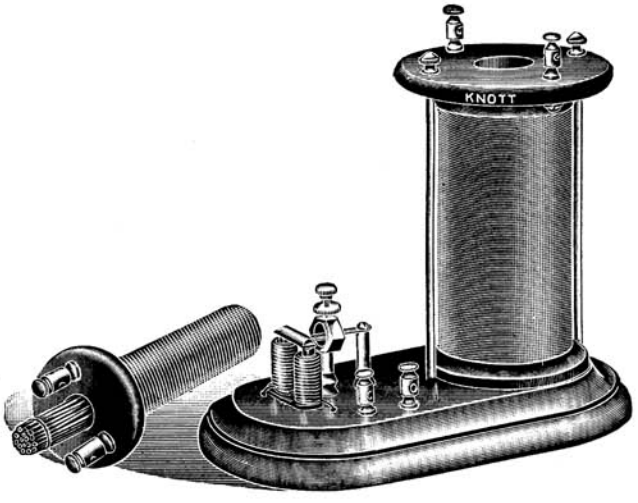
No. 95–40

No. 95–38

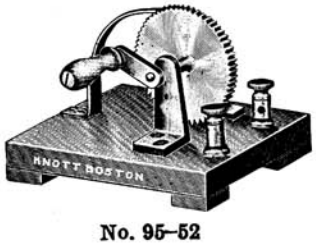
95–38 STUDENTS' PRIMARY AND SECONDARY COIL, 7½ inches high. Inner spool or primary removable, provided with soft iron core..... **$7.25**

95–40 LECTURE TABLE PRIMARY AND SECONDARY COIL, large size, for study of current induction. Primary, 6×1¼ inches, few turns of coarse wire; secondary, 5×2½ inches, large number of turns. Core consists of a bundle of soft iron wires moulded by iron bands to form a nearly solid rod. This apparatus should not be confused with designs similar to our **No. 95–38.** It is much larger, more ruggedly made, and has large capacity secondary, and will give efficient, positive results..... **17.50**

95–45 LECTURE TABLE PRIMARY AND SECONDARY COIL WITH ELECTRO-MAGNETIC VIBRATOR, different from **No. 95–40** in that the secondary is mounted on a polished hardwood base connected in series with a simple electro-magnetic vibrator added to give positive uniform "make and break" in the circuit. Demonstrates a simple induction coil without condenser... **21.00**



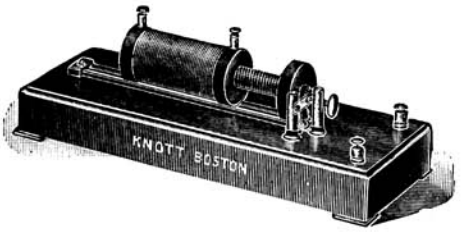
No. 95–45



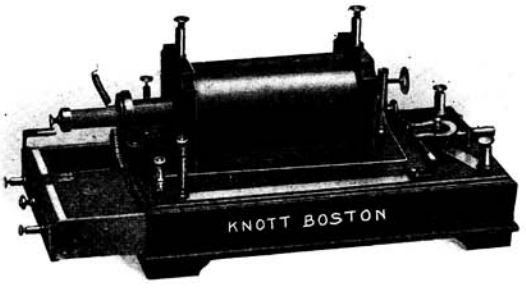
No. 95–52

95–52 INTERRUPTING WHEEL. Provides means for mechanically making and breaking a circuit — the rapidity of the interruptions depending upon the rate at which the toothed wheel is rotated. Mounted with binding posts complete as illustrated on finished hardwood base..... **4.50**

INDUCTION COILS



Nos. 95–75 to 95–80



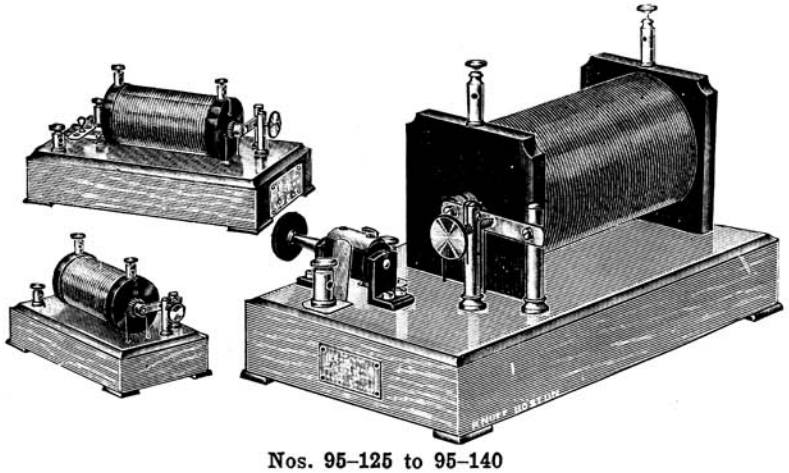
No. 95–95

95–75 **DEMONSTRATION INDUCTION COIL, ¼-inch spark.** This type of coil is of value in the study of the office of the primary in induction coil construction. Both primary and secondary are mounted on a polished mahogany box, but the mounting is designed so that the secondary may be adjusted to enclose varying amounts of the primary. This instrument is handsomely finished, all brass parts polished and lacquered **$9.00**

95–80 ——, **½-inch spark** **14.50**

95–95 **DEMONSTRATION DISSECTIBLE RUHMKORFF COIL.** This coil is constructed so that all essential details of a commercial Ruhmkorff coil may be shown as units and in their relations to the rest of the instrument. Thus the condenser is mounted in a drawer slide. Connections with the secondary are secured through binding posts. The primary may be dissected and taken from the instrument. The make and break and core are of special design calculated to teach the principle, and all connections are fully in the open and may readily be noted at a glance **57.00**

RUHMKORFF COILS



Nos. 95–125 to 95–140

Our small types of Ruhmkorff coils up to 1-inch spark are made for us by a prominent European manufacturer They are of standard quality designed for elementary work. Ruhmkorff coils with a capacity of 2 inches or more (see next page) are constructed by us in our own factory. We are, therefore, enabled to furnish a product superior in quality to that ordinarily furnished of European make. We secure a greater efficiency and are enabled to place in the hands of the buyer a more finished instrument. The parts of these coils are of the best proportions to give the maximum efficiency and preserve symmetry. Only the best quality of material is used in construction, and all parts are handsomely finished.

We are enabled to guarantee our coils up to their full capacity and warrant them against faulty construction.

EUROPEAN COILS

95–125 **RUHMKORFF COIL,** capacity ⅛-inch spark **$5.75**

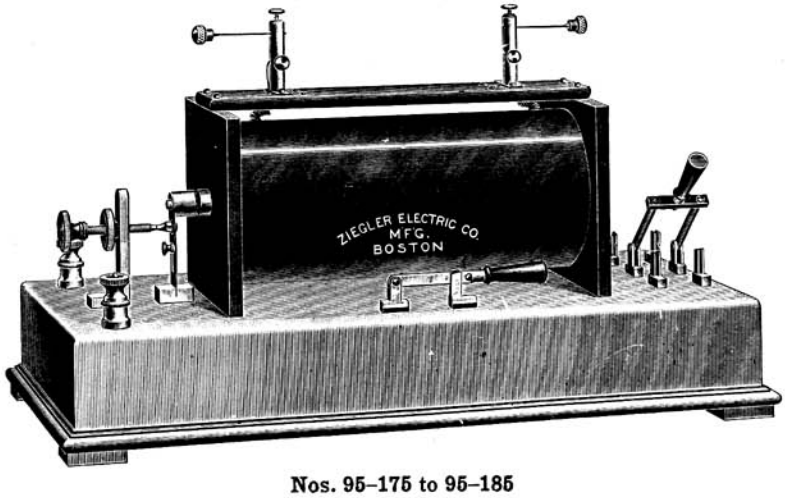
95–130 ——, capacity ¼-inch spark **7.50**

95–135 ——, capacity ½-inch spark **10.75**

95–140 ——, capacity 1-inch spark **25.00**

THE "NEW LINE" INDUCTION COILS

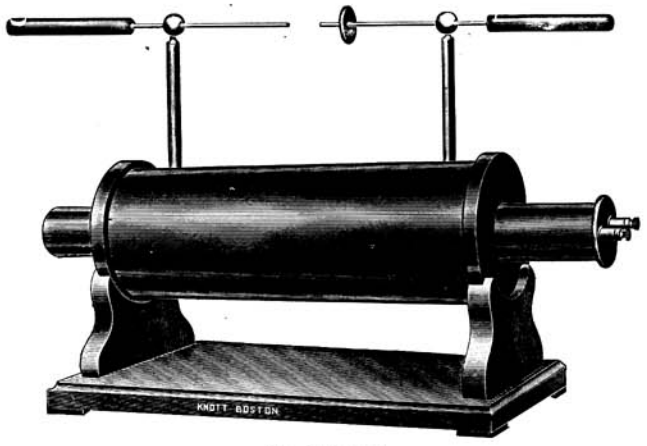
Designed for Battery Current



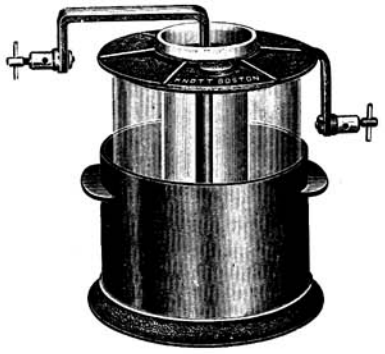
Nos. 95–175 to 95–185

These coils are constructed for heavy discharge rather than length of spark. This is obtained by use of exceptionally heavy primaries in conjunction with the best possible insulation. Every feature has been worked out with the greatest care looking towards the building of a coil which cannot be broken down and which will give the desired results on comparatively low battery power. Our induction coils are constructed according to the latest and best high tension data. We have gained much valuable information during long experience in this line of manufacture, and many novel and improved features have been embodied in the "New Line" Induction Coils which insure long life and maximum discharge on comparatively low battery power. Each coil is subjected to a vigorous test with a 100 per cent overload.

95–175 **"NEW LINE" INDUCTION COIL, 2-inch guaranteed discharge** **$65.00**
95–180 **——, 4-inch guaranteed discharge** **115.00**
95–185 **——, 6-inch guaranteed discharge** **150.00**



No. 95–230

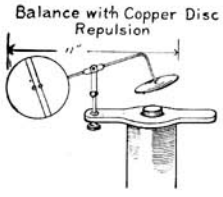


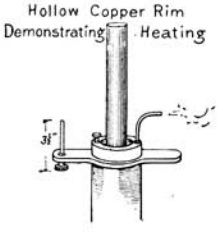
Nos. 95–250 to 95–252

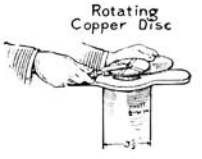
95–225 **LIQUID INTERRUPTING INDUCTION COIL for 110-volt circuit.** This coil has been designed to work on the 110-volt circuit and to withstand the entire current from Liquid Interrupter **No. 95–252.** We guarantee a heavy 7-inch discharge which will be found most satisfactory for general work in X-Ray and Wireless Experiments. Complete with Liquid Interrupter **No. 95–252** **137.50**
95–230 **——, without Interrupter** **120.00**
95–250 **ELECTROLYTIC INTERRUPTER, Type A,** for coils from 4 to 6 inch spark discharge. Electrolytic breaks have been expensive and oftentimes a failure by reason of the difficulty in adjusting the size of the gas tube to the line voltage and the amperage which is to be drawn from the break. Our Interrupter contains a porcelain cylinder in which the size of the opening is carefully adjusted to the amperage of the current to be drawn. This cylinder is carried on a lead shelf, being part of the inner lead cylinder. The terminals are carried well out on the ends of long lead bars as shown in the illustration. The acid jar is placed in an iron receptacle which acts as a radiator and serves to retain the acid in case the acid jar is accidentally broken **17.50**
95–252 **——, Type B,** for coils from 7 to 12-inch spark discharge **17.50**

ELECTRO-DYNAMIC APPARATUS FOR ALTERNATING CURRENTS

No. 95–260







95–260 ELECTRO-DYNAMIC APPARATUS. This apparatus has been designed for the purpose of showing the repulsion and rotation effects produced by an alternating current. It is designed to operate on a commercial circuit of 110 volts, the alternating current being recommended. The apparatus is complete, covering a full set of parts for performing a most instructive series of experiments. A few of these we note herewith:

Diaphragm made to vibrate in unison with the alternations of the current so as to give out a distinct tone.

Repulsion of a copper disc held in proximity to the iron core on the balance arm.

The rotation of the copper disc, caused by the revolving field.

The rotating ball. A copper ball, placed over the exposed end of the iron core and one-half of the core covered with a copper disc, will rotate. By floating the ball in a jar of water, the rotation becomes rapid.

Lighting of an electric lamp by means of the pulsations given out from the iron core, this being accomplished through the glass jar.

The suspension of a heavy metal ring placed around the iron core.

The comparative repulsion of copper and aluminum rings.

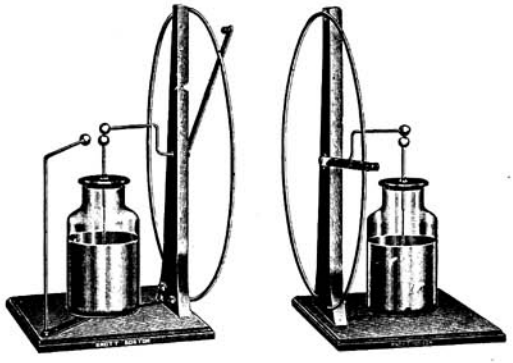
Heating effect in a copper ring, shown by the boiling of a liquid.

These and many other experiments may be performed with the above apparatus. Their striking character has caused the outfit to be extensively used on the lecture table. Complete directions for operating and performing many experiments are furnished with the outfit.

PRICE, $115.00

95–310 SEPARATELY MOUNTED RESONANT LEYDEN JARS for demonstration of,—

1. Resonance between Electrical Circuits.
2. Oscillatory Character of the Condenser Spark.
3. Tuning as Applied to so-called High Frequency Circuits, Wireless Telegraphy, etc.

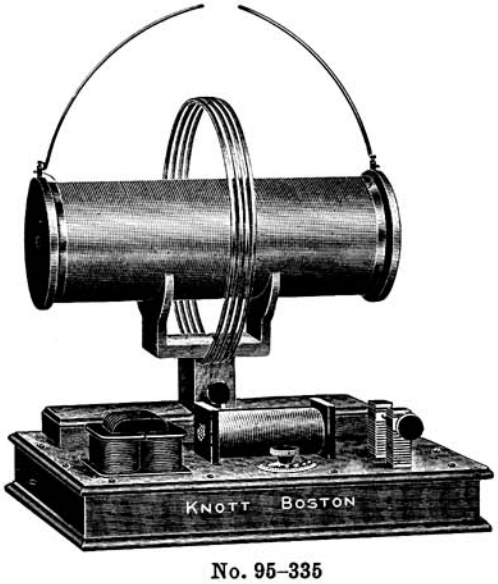


No. 95–310

These jars make an impressive and instructive lecture table outfit. In operation one of the jars should be charged by means of a static machine or induction coil, and at each discharge a simultaneous spark will be obtained from the other jar, providing that its loop is adjusted to the same position as the loop on the first. Changing the size of the loop on either of the jars without altering the other will throw them out of tune, and the charge on one will be much less than on the other. When in tune the two parts of the outfit may be removed a considerable distance apart, thus showing in a very clear manner the wonderful sensitiveness of resonant circuits.

The outfit is usually equipped with one-quart Leyden Jars, but jars either larger or smaller may be used, if at hand, thereby greatly increasing the educational value of the device, for it can be shown that to obtain resonance, the value of the condenser times the inductance or loop must be the same; i.e., a large jar discharging through a small part of the loop of conductor will energize the other or smaller jar through a larger part of its circuit, etc.

Complete as illustrated **$37.00**



No. 95–335

95–335 HIGH FREQUENCY INDUCTIVE APPARATUS. Combines open type of resonator with closed core type of transformer and silver spark gap. Designed for a comprehensive study of the high frequency field, including wireless telegraph waves and kindred subjects. Excites all types of vacuum tubes and will produce X-Rays of surprising power and penetration. Connected on a 110-volt alternating current, will furnish a discharge of any desired value up to its full capacity — about 12 inches. Highest grade material throughout; the workmanship the best that mechanical skill can produce **$210.00**

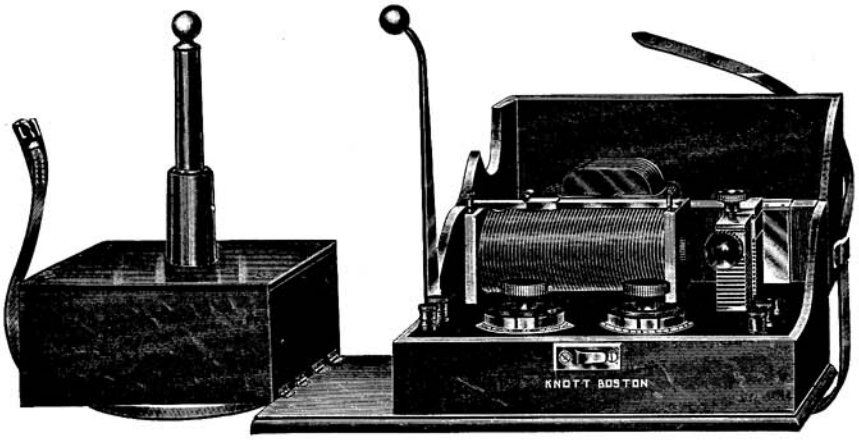
HIGH FREQUENCY

Experimental work with high frequency currents has been impeded by the lack of well-designed apparatus in marketable form. The coils which are listed on the following pages are the results of fifteen years' experience in the construction of high frequency apparatus, the first coil of this general type being built by us in the early days of high frequency work. It has taken years of careful study, however, to learn how best to combine the elements embodied in these instruments to produce a compact, safely handled coil giving adequate power with a range of adaptability which would especially fit it for a scientific study of high frequency phenomena.

No. 95 – 325

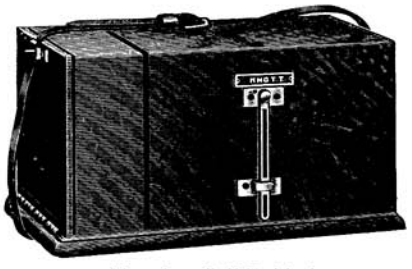
UNI-POLAR HIGH FREQUENCY COIL

TEN-INCH CONTINUOUS DISCHARGE



No. 95–325

This instrument is a most striking outfit for general lecture work and for exhibition. It is built on lines that have proved successful in the highest grade instrument construction. Not only does its peculiar compact design protect the working parts when not in use, but it also affords an instrument that is readily transportable from place to place. Although when folded it occupies $16\frac{3}{4} \times 8\frac{1}{2} \times 9\frac{5}{8}$ inches, when open, it is not only large, but all the vital parts are held at a considerable distance apart, so that a very large amount of energy can be handled without overloading or subjecting the various parts to an undue strain. The instrument is entirely self-contained and after being connected to the lighting circuit by means of a cord and plug, it is ready for use.



Showing Coil Folded

We desire to call particular attention to the construction of this coil. Its design has been the result of careful investigation, and the expenditure of a great amount of time and money. It comprises no new or untried parts or material. We have watched its development and operation for several years, and when thoroughly convinced of its merits, utility, and "standing-up" qualities, made arrangements with its inventor for its sale to educational institutions. We are enabled to fully guarantee this coil against accidental "break-downs" and against "burn-outs."

Designed for alternating current, complete with carrying strap, connecting cords and Edison plug, and with pamphlet descriptive of care and use.

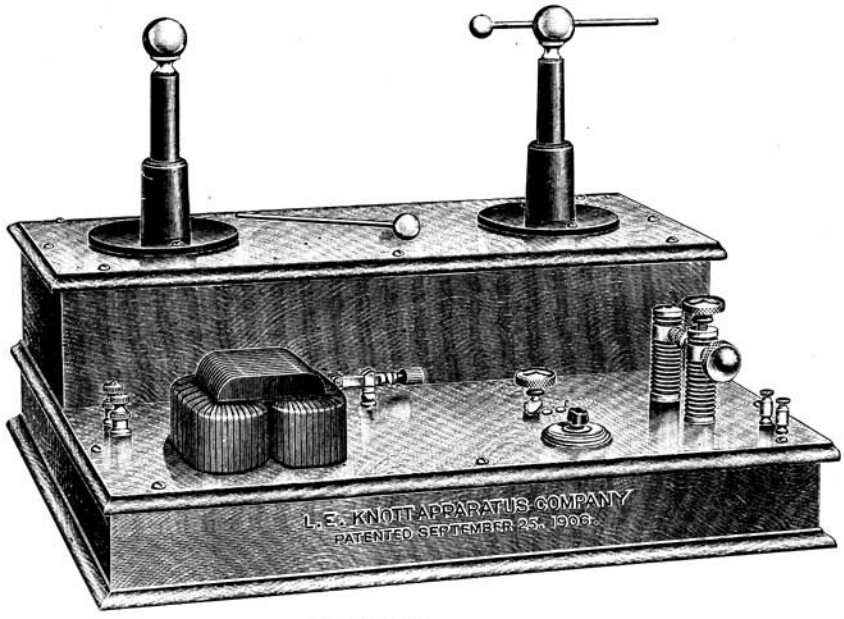
PRICE, $240.00

No. 95–340

BI-POLAR HIGH FREQUENCY COIL

TWELVE-INCH CONTINUOUS DISCHARGE

Designed for Alternating Current



No. 95–340

95-340 BI-POLAR HIGH FREQUENCY COIL. This coil is designed to furnish a powerful high frequency discharge, suitable for X-Ray work and general experiments requiring high voltage. It is of ample proportions and entirely self-contained. It is of the bi-polar type, i. e., each terminal is active and throws off an abundance of energy when in operation. The instrument is fitted with an experimental circuit for demonstrating the laws and performing the many interesting and instructive experiments pertaining to high frequency phenomena. Our coils are built for service, only the best of material being used in their construction. They are built on lines that positively avoid the danger of expensive "break-downs," such as are met with in the old style of induction coils. Each coil is fully guaranteed against mechanical and electrical imperfections.

Complete with connecting cord and Edison plug and with complete directions for care and use.... **$200.00**

95–350 ROTARY CONVERTER for operating above coil on 110-volt D. C. circuit. Operates on 110 volts D. C. to give an alternating current of 77 volts, 60 cycles; normal capacity 600 watts. Large size frame to withstand considerable overload. Can be used for any purpose where the alternating current is required..... **50.00**

95–375 HIGH FREQUENCY PHENOMENA APPARATUS. For the convenience of teachers who desire to give a course in high frequency currents we have designed apparatus capable of performing all the experiments outlined on the following page and many others incapable of adequate illustration.

High Frequency Phenomena Apparatus sufficient for performing all the experiments outlined on the following page. In neat wooden case but without X-Ray Tube..... **39.50**

HIGH FREQUENCY PHENOMENA

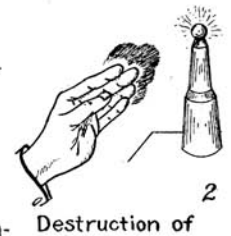
Illustrating

Twenty-five Of The Many Possible Experiments

Melting wire held in hand

1

Brush Discharge from Hand

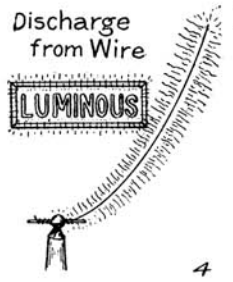


2

Brush Discharge Ozone Generator

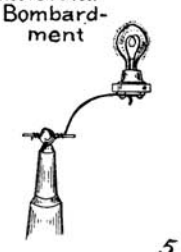
3

Discharge from Wire



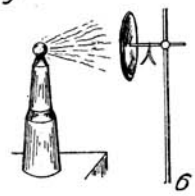
4

Molecular Bombardment



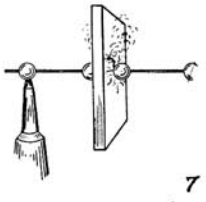
5

Transformation into Static Electricity



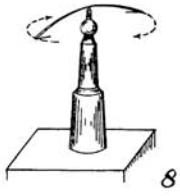
6

Destruction of Dialectric



7

Electric Whirl

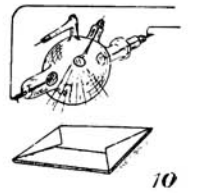


8

Effect of Air Blast on Discharge

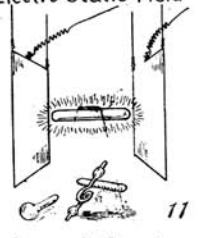
9

X-Rays Radiography Fluoroscopy



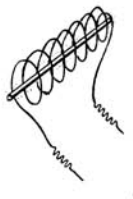
10

Lighting Vacuum Tube without connection Electro Static Field



11

Hysteresis Heating Iron

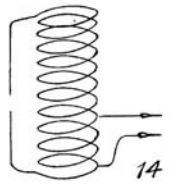


12

Self Induction Marked Drop in Voltage

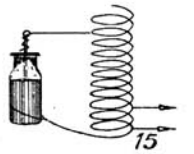
13

Stepping up Voltage with forced oscillations in self induction helix



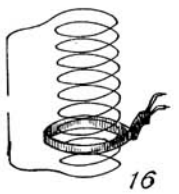
14

Resonance in Helix



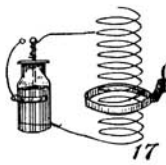
15

Primary and Secondary Induced Forced Currents



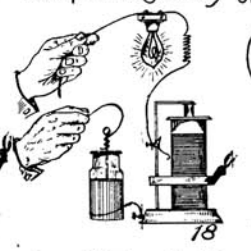
16

Primary and Secondary Induced Resonant Currents



17

Lighting Commercial Lamp through Body

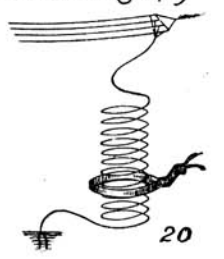


18

Lighting Lamp on one wire

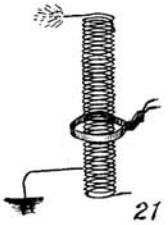
19

Wireless Telegraphy



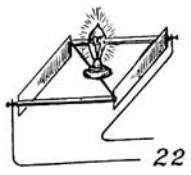
20

High Voltage Resonant Helix



21

Surface Resistance

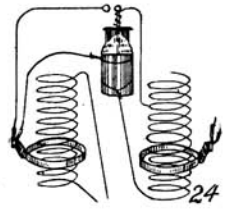


22

Ultra Violet Light Fluoresence

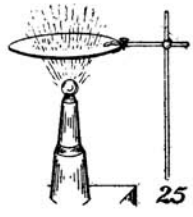
23

Very High Frequency



24

Radiation through Dialectric



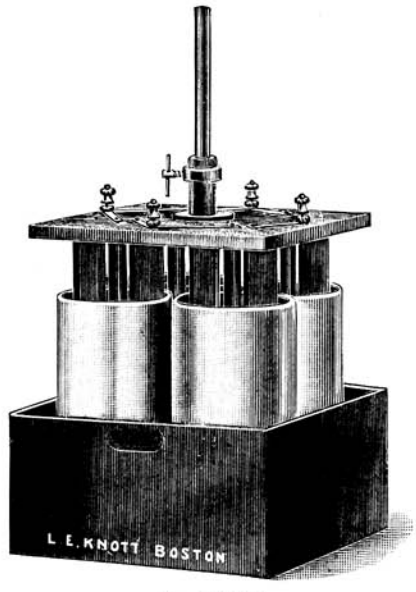
25

ELECTROLYTIC RECTIFIERS

95–485 ELECTROLYTIC RECTIFIER, Nodon valve type, designed **for use on 110-volt alternating current,** giving a direct current of the pulsating form, but one in which the negative part of the wave is entirely cut off, so that for most purposes this transformed current takes the place of a direct current of equal voltage. Charging of storage batteries, experiments in electrolysis, charging of electromagnets, complete series of experiments showing the mutual attraction and repulsion of currents, etc., may be performed with this current.

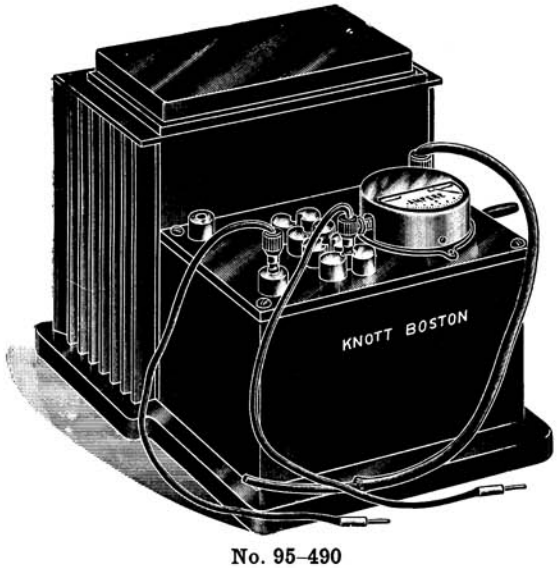
The valve here illustrated is of substantial construction, jars, lead plates, aluminum rods of generous proportions, slate top and connectors, substantial iron rod support and wooden carrying case. Large amperage may be drawn from this instrument, but for brief periods only, owing to the fact that no adequate arrangements have been made for radiating the heat. Full directions for connections and use furnished with each instrument.

Complete **$39.75**



No. 95–485

95–490 THE NEW MULTIPLE RANGE SELF-COOLING RECTIFIER, with ammeter, designed **for use on 110-volt alternating current** and **to deliver a direct current** of **varying voltages.** As ordinarily furnished, **3, 6, 9,** and **12 volts** have been provided for, being the ranges most generally useful in laboratory work. In addition to these a **12-volt alternating current** may also be drawn. As will be noted from the illustration, the instrument is provided with an ammeter so that the exact consumption on the direct current circuit may be noted constantly.



No. 95–490

The terminals on the top of the case are connected to various sections of the transformer, each clearly marked so that the user can tell at a glance what voltage he is drawing.

General construction. Owing to the care which has been taken to properly dissipate the heat, large amperage may be drawn from this instrument continuously. The metal case is made with radiating vanes, the case itself serving as one of the electrodes, so that the heat generated is taken care of by conduction and radiation as fast as produced.

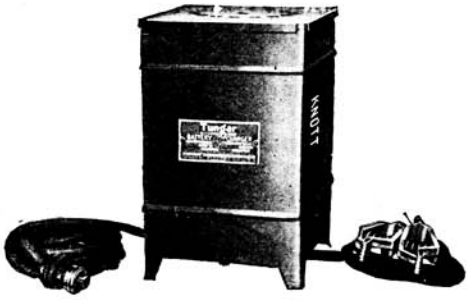
This outfit will be found not only much more convenient to use than the electrolytic rectifiers of the type **No. 95–485,** but is also much more efficient. The fact that multiple voltages can be drawn enables it to fill a need in laboratory work which has long been felt. These instruments should be provided in every laboratory where a direct current of low voltage is not already provided for. Complete directions furnished with each instrument.

Complete with ammeter, mounted as shown in the illustration **$77.50**

TUNGAR RECTIFIERS

for use on
Alternating Current Circuits, 105/125 Volts, 60 Cycles
to change
Alternating to Direct Current

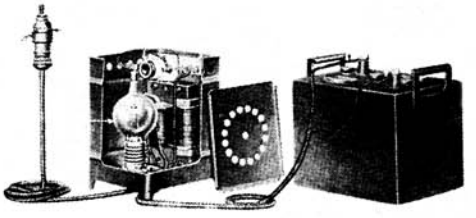
No. 95–501



No. 95–507

The Tungar Rectifier consists of a small transformer, a Tungar bulb andf use neatly enclosed in a black japanned sheet-metal casing. There is nothing to get out of order and the rectifiers require no attention. The life of the Tungar bulbs, however, is not guaranteed. The average bulb will run from 2000 to 5000 hours, when it is necessary to renew.

To start the Tungar Rectifier, the alternating current lead is connected to any ordinary lamp socket and the two direct current leads to their respective poles (red lead to positive (+) pole; black or white lead to negative (—) pole), and the alternating current turned on. The rectifier may be set on a bench or chair, or fastened to the wall or a panel.



Illustrating Tungar in Use

Form A Tungar Rectifiers

This type has an auto-transformer in the case, **the primary coil of which is not insulated from the secondary.** It is, therefore, particularly adapted for automobile storage battery charging.

95–501 **TUNGAR RECTIFIER, 2/1 amperes at 7.5/15 Volts Direct Current.** Will charge a 3-cell battery at 2 amperes, a 6-cell battery at 1 ampere, or an 8-cell battery at 0.75 ampere. Case measures $8\frac{3}{16}\times6\frac{3}{16}\times5\frac{3}{4}$ inches. Weight 8 lbs. **$20.00**

95–503 ——, **5/3 amperes at 7.5/15 Volts Direct Current.** Will charge a 3-cell battery at 5 amperes, a 6-cell or two 3-cell batteries at 3 amperes, a 9-cell or three 3-cell batteries at 1.5 amperes. Case measures $9\frac{11}{16}\times6\frac{3}{16}\times7\frac{3}{16}$ inches. Weight 15 lbs. **32.00**

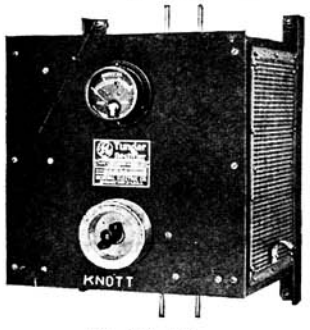
Form B Tungar Rectifiers

This type has an auto-transformer in the case, **the primary coil of which is insulated from the secondary.** It is, therefore, indispensable when used to charge storage batteries for call-bells, buzzers, telephones, clocks, etc.

95–505 **TUNGAR RECTIFIERS, 2/1 amperes at 7.5/15 Volts Direct Current.** Will charge a 3-cell battery at 2 amperes, a 6-cell battery at 1 ampere, or an 8-cell battery at 0.75 ampere. Case measures $8\frac{3}{16}\times6\frac{3}{16}\times5\frac{3}{4}$ inches. Weight 8 lbs. **$28.00**

95–507 ——, **1.25/25 amperes at 24/30 Volts Direct Current.** Will charge 9-12 cells at 1.25–2.5 amperes. Case measures $9\frac{11}{16}\times6\frac{3}{16}\times7\frac{3}{16}$ inches. Weight 15 pounds **45.00**

95–509 ——, **5/3 amperes at 7.5/15 Volts Direct Current.** Will charge a 3-cell battery at 5 amperes, a 6-cell or two 3-cell batteries at 3 amperes, a 9-cell or three 3-cell batteries at 1.5 amperes. Case measures $9\frac{11}{16}\times6\frac{3}{16}\times7\frac{3}{16}$ inches. Weight 15 lbs. **40.00**



No. 95–511

Prices of Other Sizes on Application

95–511 **FULL WAVE TUNGAR RECTIFIER, 10 amperes at 22/30 Volts Direct Current.** The above Tungars are half-wave rectifiers and, therefore, cannot be used directly to operate small motors, electromagnets or other electrical devices requiring a low voltage direct current circuit. This Full Wave Tungar can be used directly to operate such electrical devices at an efficiency of about 58 per cent. Case measures $8\frac{3}{16}\times6\frac{3}{16}\times5\frac{3}{4}$ inches **150.00**

Prices of Other Sizes on Application

95–514 **TUNGAR RENEWAL BULBS** for **Nos. 95–501, 95–503** and **95–505** Tungar Rectifiers ..... Each **6.00**

95–516 **TUNGAR RENEWAL BULBS** for **Nos. 95–507, 95–509** and **95–511** Tungar Rectifiers ..... Each **12.00**

Two pairs of covered wires come with each Tungar Rectifier, one pair with an attachment plug for connection to the lamp socket.

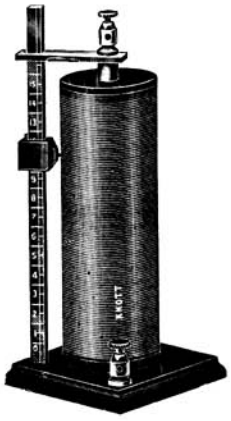
ROTARY CONVERTERS
Changing D. C. to A. C.

MOTOR GENERATORS
Changing A. C. to D. C.

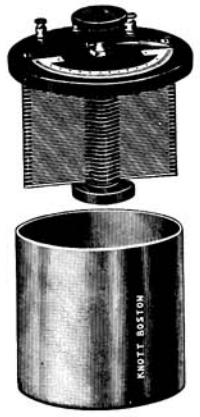
Specify Line Voltage and Work for which Intended

Prices on Application

INDUCTANCE AND CAPACITY APPARATUS



Nos. 96–60 to 96–65



Nos. 96–135 to 96–140

96–60 **ADJUSTABLE INDUCTANCE.** These inductances are made up of copper wire wound on a threaded hard rubber tube — a construction that has been found to give excellent results both mechanically and electrically. A smooth-acting slide permits any desired amount of the wire to be placed in circuit, and a scale on the slide support gives the value of the portion in use. These inductances will be found well suited and convenient to use in connection with High Frequency currents and Wireless Telegraph outfits. Capacity 1000 Microhenrys..... **$30.00**

96–65 **——, capacity 5000 Microhenrys**..... **45.00**

96–105 **CONDENSERS, paper and tinfoil.** These condensers have an average insulation resistance of 100 megohms and not less than 50 megohms per micro-farad.

	a	b	c
Capacity.....	½	1	2 M. F.
Each.....	**$2.50**	**3.40**	**4.00**

96–110 **SUBDIVIDED PAPER CONDENSER, ½ to 2 M. F. by ½ M. F. steps.** Enclosed in polished wooden case..... **18.00**

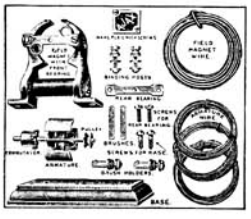
96–135 **VARIABLE AIR CONDENSER. Capacity .001 M. F.** This is a standard instrument constructed of the highest quality material and of first-class workmanship throughout. The vanes are of aluminum, and the moving system works perfectly without interference of the plates or other objectionable features commonly met with in instruments of cheaper construction. The top is of the best grade hard rubber, insuring high insulation and durability. A binding post is provided connecting to the case for grounding in experiments where the utmost accuracy is required. These condensers will be found of great usefulness in wireless telegraphy and in experiments with currents of high frequency..... **56.00**

96–140 **——, capacity of .005 M. F.**..... **77.00**

ELECTRO-DYNAMIC APPARATUS

Dynamos and Motors

Battery Current



No. 97–10

No. 97–15

No. 97–25

No. 97–30

97–10 **MOTOR PARTS, complete parts for assembling a working motor.** All parts ready to wind and assemble are enclosed with simple directions in a neat cardboard box. These parts and directions may be placed in the hands of any ingenious pupil who can readily assemble a motor for himself... **$2.25**

97–15 **SIMPLE BATTERY MOTOR.** Will run on a single battery cell. A compact, well-made, toy motor which, with **No. 97–17,** serves to demonstrate the operation of a simple motor generator..... **2.50**

97–17 **SERIES-WOUND DYNAMO (GENERATOR),** same type of instrument as **No. 97–15,** with which it can be used to demonstrate the operation of a simple motor generator **3.00**

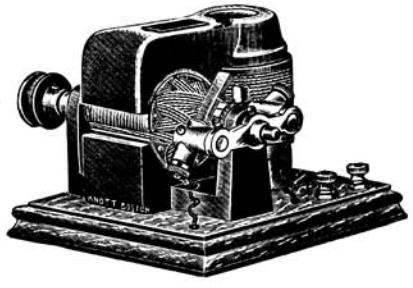
97–60 **STUDENTS' MOTOR GENERATOR.** Consists of **Nos. 97–15, 97–17,** and **97–62**..... **6.15**

97–62 **MOTOR GENERATOR BED CLAMP.** A cast metal frame to hold **Nos. 97–15** and **97–17** rigidly in position for use as a motor generator. Provided with simple adjusting screws for tightening the belt..... **.65**

97–25 **STANDARD MOTOR.** Operates on 2 to 3 cells of battery. With average load will run about 2200 R.P.M. when connected to a current of 2 amperes at 4 volts..... **7.50**

97–30 **REVERSING LEVER MOTOR.** Operates on 2 to 3 cells of battery. About 3¼ inches high. Note reversing lever designed to start, stop or reverse the motion of the armature..... **4.80**

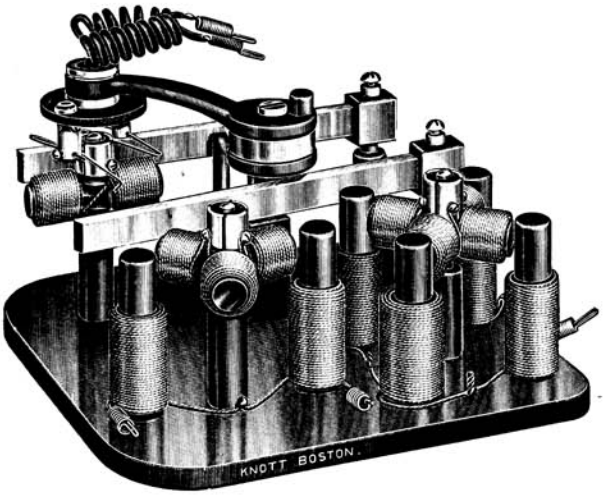
97–40 **POWER BATTERY MOTOR,** similar in appearance to **No. 97–30,** but does not have the reversing lever. Is larger in size and of better workmanship and finish. A high-grade battery motor..... **5.70**



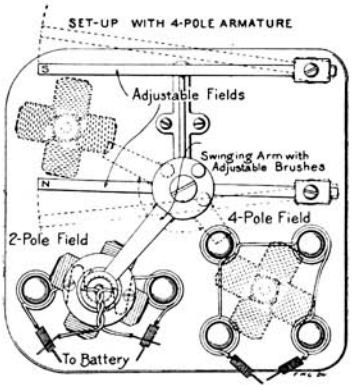
No. 97–70

97–70 **DYNAMO MOTOR.** As a dynamo its output at full speed of 3000 to 3200 R.P.M. is about 30 watts (2.5 amperes at 12 volts). It will be found useful for furnishing current for many experiments in the study of electricity and magnetism. It will charge a 6-volt 40-ampere-hour storage battery in 12 hours. As a motor it operates on 6 to 12 volts of battery current, giving about 1800 R.P.M. at 8 volts and 2500 R. P. M. at 12 volts. It will develop about 1/25 H.P. This dynamo motor is furnished with a pulley 1½ inches in diameter, V-groove for a $\frac{5}{16}$-inch round belt **11.00**

DEMONSTRATION DYNAMOS AND MOTORS



No. 97–100



No. 97–100 (Fig. 1)

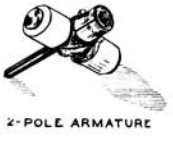


Fig. 2

Fig. 3

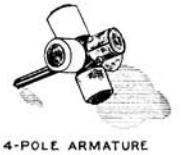


Fig. 4

97–100 MOTOR DYNAMO DEMONSTRATION APPARATUS. From an educational point of view, teachers will appreciate the open construction and the ease with which the student may see at a glance the various poles of either type of dynamo or motor, and in consequence be free from the perplexing problem of determining the exact position of the pole. Some of the points that may be easily studied by the student are briefly outlined as follows:

1. The two-pole magneto.
2. The two, three, or four-pole armature in a two-pole field.
3. The effect of varying the strength of the field.
4. Shunt-wound motors having like or unlike number of armatures and field poles.
5. Series-wound motors having like or unlike number of armatures and field poles. (This point is rendered especially easy since all the armatures are interchangeable with all the field systems so that they are easily combined in any desired manner.)
6. A study of the neutral point.
7. A study of the effect of changing the direction of the current in either armature or field. Many other experiments applicable to the dynamo and motor may be readily performed. Complete as illustrated.

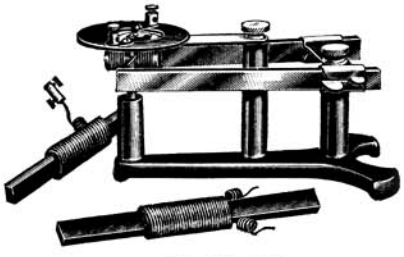
PRICE, $9.75

97–105 METAL MOUNTED IMPROVED ST. LOUIS MOTOR, with improved brush carrier and armature. This apparatus is an improved form of the apparatus known as the St. Louis Motor. It may be used as a dynamo or motor. Although similar to **No. 97–100** in its application to principles of dynamo and motor construction, it is limited in range of experiments possible. It serves effectively, however, to teach with permanent field magnets,—

1. Strength of magnet field at different distances from armature.
2. Effect of two like and effect of two unlike poles; with electromagnet field, series and shunt dynamo.

It is a simple and effective means in individual laboratory work of making simple and clear,—

1. Polarity of armature at different points in its revolution.
2. Direction of current in armature and field.
3. Commutation, position of armature, commutator and brushes.



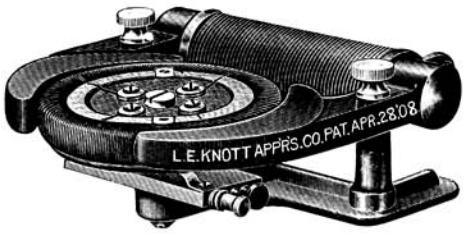
No. 97–105

Complete as illustrated, with permanent magnet and electromagnetic attachments.

PRICE, $7.75

No. 97–115

GILLEY GRAMME MACHINE



No. 97–115 Fig. 1

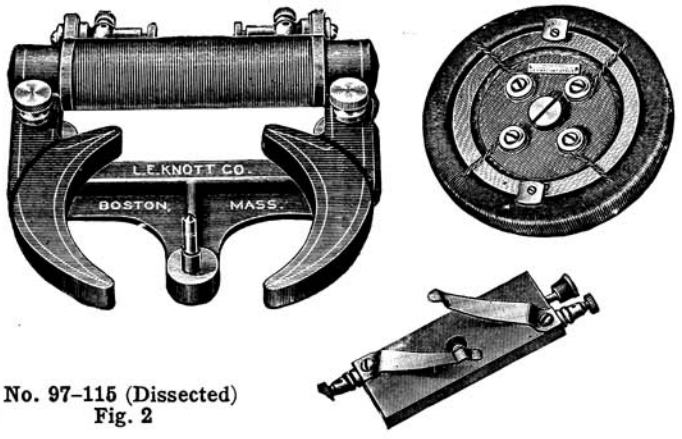
The Gramme Machine represents a type of generator now generally used in large units for power and lighting stations. The Gilley Gramme Machine is a modification so worked out that the lines of force may be easily plotted by the compass and filings method.

No other apparatus has yet been designed with which it is possible to show the lines of force in a working model of the dynamo and motor with the armature in position and in actual operation. Both the field and armature are designed and made in flat form, so that the upper surfaces of both are level, permitting the paper or glass upon which the lines of force by the filings method are to be mapped, to take a smooth horizontal position. The lines of force are thus permitted to arrange themselves under no other influence than that of the magnetic force existing in the armature and field.

Dissectible Features. Fig. 2 shows the three basic parts of the apparatus — the armature with the commutator, the field magnet with base, and the brush-holder. The instrument is readily dissected, as the illustration shows. Each part can be studied separately, as will be noted from the following list of experiments.

We desire to call attention also to the fact that the field coil is easily removed from its base and the base so designed that 6-inch permanent magnets can be substituted for the field coil, thus teaching the fundamental principle of the magneto.

WHAT THE INSTRUMENT IS DESIGNED TO TEACH



No. 97–115 (Dissected) Fig. 2

Experiment 1. **Study of the field magnet in an electromagnet,** the lines of force being mapped out either by compass or filings method.

Experiment 2. **To show what effect the soft iron ring of the armature has upon field magnets.** The value of this exercise is greatly increased by using the filings method of mapping the field and comparing the field with results obtained above.

Experiment 3. **A detailed study of the armature,** showing that it is wound in sections and where the ends of each section are.

Experiment 4. **A detailed study of the commutator by passing the current into the armature magnet through the brushes,** showing by this method the exact position of each section when polarity is reversed.

Experiment 5. **The method of answering definitely why the armature of a motor rotates.** The action of the lines of force as indicated by the fiings method will make this clear.

Experiment 6. **A study of the magneto generator and its relation to the regular commercial dynamo,** showing definitely why the current is generated when the armature is rotated between the poles of a magnet.

Experiment 7. **A study of the magneto and its relation to the dynamo,** also why the armature in a magneto machine rotates.

Experiment 8. **A study of the dynamo using electromagnetic field and armature.** Determining the relation of the armature to the field coils and the speed of the armature to the strength of the magnetic field.

Experiment 9. **The study of different types of dynamos and motors** depending upon whether the armature and field are connected in series or in multiple, and what are the conditions regulating the method of connecting in any given machine.

Experiment 10. To show what the result will be if the armature is removed and a permanent bar magnet mounted on the same bearing. This experiment teaches clearly the reason **why the armature must be an electromagnet and not a permanent magnet.**

PRICE, $14.50

No. 97 - 125

MILLER-COWEN
DYNAMO ELECTRIC MACHINE

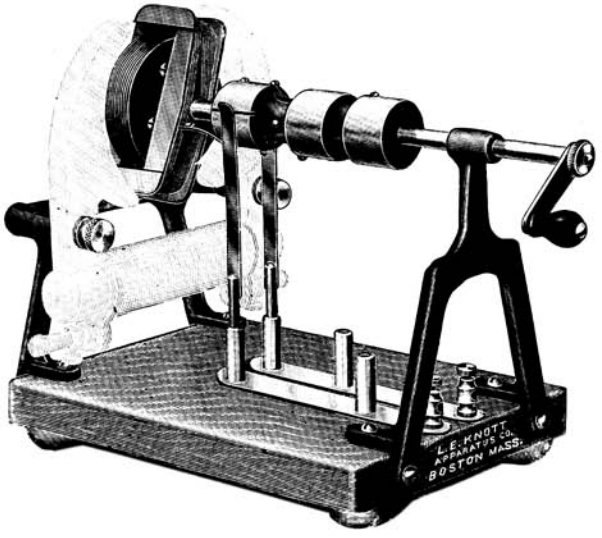
For study of Both Alternating and Direct Currents

Serves effectively to demonstrate

Alternating Currents
Direct Currents
Use of Commutator
Effect of Speed on Rotation
Dynamos — Separately and Self-Excited
Alternators
Direct-Current Generators
Dynamos and Motors — Series — Shunt — Compound

The galvanometer used should not be of high sensibility. Any milliamperemeter in good working order may be used to advantage. We recommend our **No. 93–130** Universal Lecture-Table Galvanometer as especially well adapted to the work.

The following line drawings suggest a few of the many possible lines of study:



Field Magnet shaded to show how, by removing the two knurled-headed screws, it may be dismounted.

Alternating Current Generator

Fig. 1

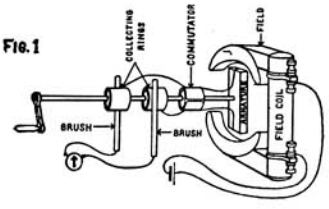
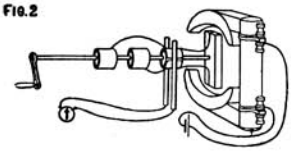


Fig. 1 shows the **open construction of the various parts.** The rings and commutator large in proportion to size of armature and other parts.

Separately excited field coil, galvanometer to brushes in contact with collector ring.

Direct Current Generator

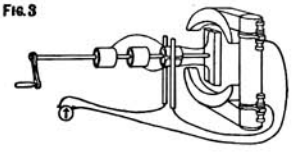
Fig. 2



Separately Excited Dynamo

Direct Current Generator

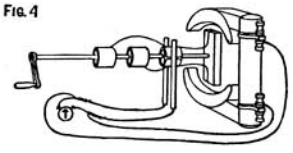
Fig. 3



Self-Excited Series Connected Dynamo

Direct Current Generator

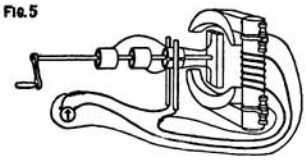
Fig. 4



Self-Excited Shunt Connected Dynamo

Direct Current Generator

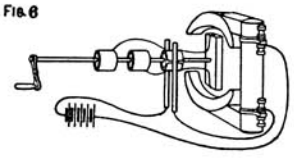
Fig. 5



Self-Excited Compound Connected Dynamo

Dynamo Run as Motor

Fig. 6



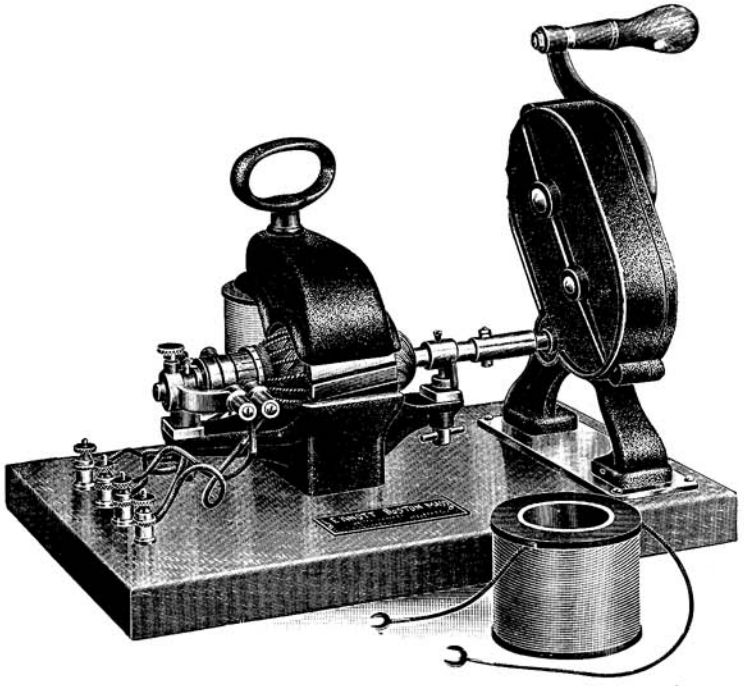
Requires 8 to 10 volts Battery Current

Brushes should be moved to make contact on collector rings in Figs. 3, 4 and 5, **to study Alternating Current Generators.** Detailed directions for study of connections shown above and other experiments may be obtained on application, and are supplied with each machine. Complete as illustrated with field magnet.

PRICE $19.75

No. 97–148

DIRECT-CONNECTED HAND-POWER DYNAMO AND MOTOR



No. 97–148

This instrument is provided with coils, collecting rings and commutator so that it will work to highest efficiency in the production of either alternating or direct current. As ordinarily used on the lecture table the output may be roughly stated as 15 volts and 7 amperes, but a greater output can be obtained if desired.

Field and armature may be connected in series or shunt, making it possible to teach definitely — **Direct-Current Shunt-Wound Dynamo, Self-Exciting Alternating Current Dynamo, Series Dynamo Motor, Rotary Converter or Motor Generator.**

SPECIAL FEATURES

Dissectibility. Pole pieces separated and armature removed without the use of wrench or screw driver. Can be taken apart and reassembled on the lecture table while the lecture is in process.

Efficiency. Will easily generate 100 watts of electrical energy and is guaranteed to give 200 watts — a new accomplishment in instruments for educational work.

Design. Careful study has been made of commercial types which we have modified only to the extent of obtaining the dissectible and educational features which we consider of prime importance.

Driving Mechanism. In eliminating the belt and substituting the enclosed oil-immersed, direct-connected gear drive, a long step in advance has been made in the construction of Hand-Power Dynamos. By careful estimate, this method of drive gives an increased efficiency of about 60 per cent.

Field Magnet. Two-pole type which allows the use of a large amount of iron and permits of a construction which makes the shortest magnetic circuit, at the same time allowing a clear view of the pole pieces and their relation to the armature.

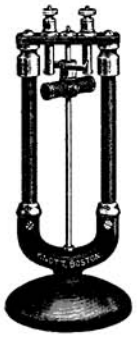
Field Coils. Wound on thin spun-metal bobbins, each core designed for a definite purpose, depending upon whether the instrument is to be connected series or shunt wound, giving the greatest efficiency for each type.

Armature. Drum type, which has proved best suited for withstanding hard usage. The coil sections are wound in slots in the laminated iron core.

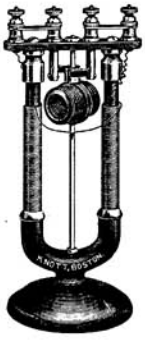
Commutator. Larger size proportionately than would be used on a regular commercial machine, for the reason that it is a part of the design of this instrument that all of the essential features be large enough for the students to readily study their functions.

Collecting Rings. Placed on the same end of the shaft as the commutator, a design which simplifies the instrument. The attachment holding the brushes serves both for alternating and direct circuit, thus offering a ready method of comparison.

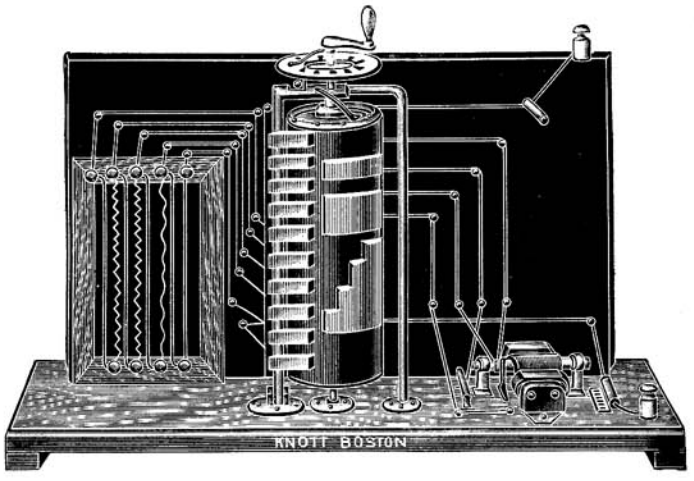
PRICE, $85.00



No. 97-160



No. 97-165

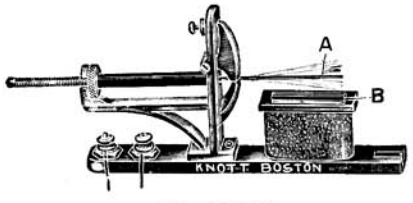


No. 97-285

97-160 PAGE MOTOR APPARATUS, Permanent Magnet Field. Demonstrates the basic principles of the electric motor and dynamo. Can be used either as a generator or motor. Note open construction and simplicity of design. Most satisfactory results guaranteed whether used by students or instructor. Exceptionally well made and finished **$16.00**

97-165 PAGE MOTOR APPARATUS, Electromagnetic Field. Recommended as a companion instrument to the Page Motor Apparatus **No. 97-160** having permanent magnet field. Open construction, clear differentiation of parts, commutator, binding posts and brushes for connecting in various series and shunt combinations are placed so that they can be clearly inspected. A most valuable instrument in the teaching of electro-dynamics. Well made and handsomely finished throughout. **19.25**

97-285 CONTROLLER MODEL. This device is designed to illustrate in a practical manner the method of controlling the speed and operation of the modern electric railroad motor. The commutator, resistances, etc., are well worked out in open construction so that the various changes that occur and their effects upon the model motor may be noted with ease and accuracy. The construction is substantial, parts clearly shown, and the whole design well suited for its didactic purpose. Complete as illustrated with motor **75.00**



No. 97-305

97-305 PROJECTION FREQUENCY INDICATOR for 110 Volt A. C. Circuit. This instrument is designed primarily to show on the screen the effect produced by an alternating current on an electromagnet The length of the vibrating reed is such as to show clearly on the screen, the ¼ wave length, the ½ wave length, and the ¾ wave length. In use the instrument is connected directly to 110-volt circuit without additional resistance **14.50**

MOTORS

Alternating and Direct Current

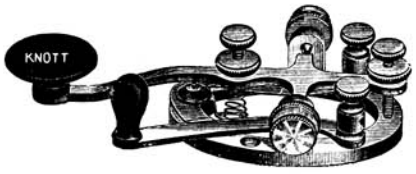
GENERATORS

Specify Line Voltage and Capacity Output Required

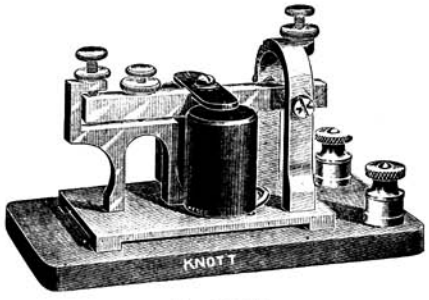
Prices on Application

TELEGRAPHY AND TELEPHONY

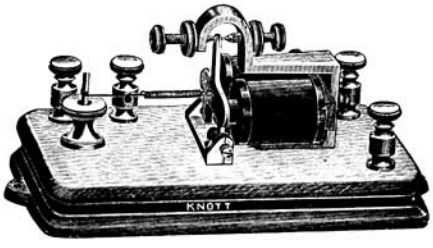
TELEGRAPH INSTRUMENTS



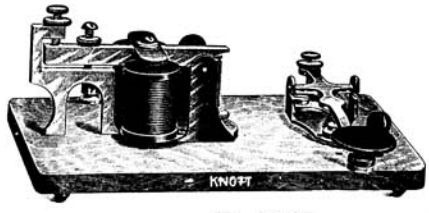
No. 98–10



No. 98–15



No. 98–20



No. 98–25

98–10 **TELEGRAPH KEY,** nickel-plated lever, brass frame, gutta-percha knobs, improved adjustment spring holders, all parts finely finished, without legs **$2.50**

98–12 **TELEGRAPH KEY PARTS** (see National Physics Direction Sheets, Exp. E100) ..... Set **2.00**

98–15 **IMPROVED SOUNDER,** unequalled for quick action, loudness, and clear tone, proportioned scientifically correct, brass lever, resistance 4 ohms **3.75**

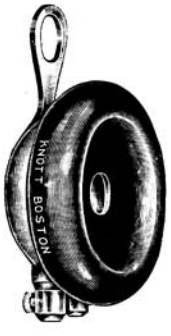
98–17 **TELEGRAPH SOUNDER PARTS** (see National Physics Direction Sheets, Exp. E100) ..... Set **2.75**

98–20 **TELEGRAPH RELAY,** excellent quality, finely finished and mounted on polished mahogany base with ornamented metallic sub-base. Standard resistance of 4 ohms **5.00**

98–25 **COMBINATION KEY AND SOUNDER.** This instrument is designed to fulfill the requirements of a short-line apparatus. The sounder magnets, lever, anvil, and key lever are the same as used on the preceding instruments. The frames for holding the sounder lever and key lever are stamped from wrought iron and heavily japanned. The base is constructed of polished mahogany. This instrument will give entire satisfaction on lines up to five miles in length. Resistance 4 ohms..... **4.50**

TELEPHONE INSTRUMENTS

No. 98–100



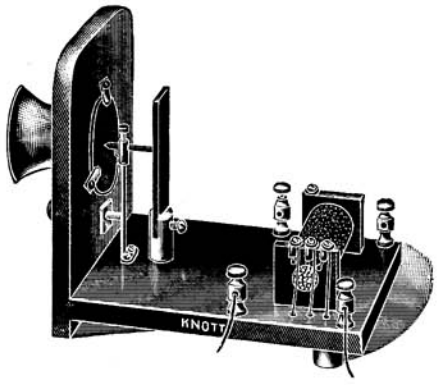
No. 98–105

No. 98–110

98–100 **DEMONSTRATION POSTLESS BI-POLAR RECEIVER.** As may be noted from the illustration, this instrument is entirely dissectible, and in consequence has a value as a demonstration instrument, as well as that of a working receiver. All parts are carefully fitted and finished and the receiver is high grade in every respect **$2.75**

98–105 **SOLID BACK WATCH CASE RECEIVER,** 2¼ inches diameter, weight 6 ounces, resistance 75 ohms, rigid adjustment. This is a simple receiver sufficiently sensitive for practically all laboratory work **1.60**

98–110 **SOLID BACK LONG-DISTANCE TRANSMITTER.** This transmitter is the standard commercial type furnished on long-distance telephones. They articulate distinctly and plainly with no up-and-down variations or sizzling **3.60**

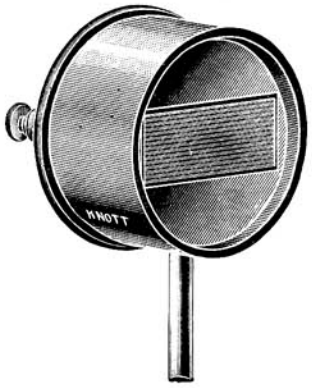


No. 98–125

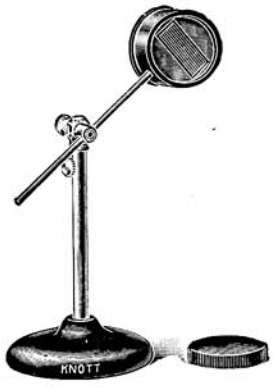
98–125 TELEPHONIC MICROPHONE. This instrument illustrates in a clear and comprehensive manner not only the microphone but its adaptation in the articulating telephone. It is in reality two instruments in one, requiring only the simple adjustment of a thumb screw to change it from a simple contact telephone to a practical working telephone. The small induction coil on the base shows the manner of raising the potential of the telephonic circuit, which is inductively connected. The results attending the connecting of the instrument with an ordinary telephone receiver and battery cell are surprising. The ticking of a watch or the fall of a feather is heard with remarkable distinctness **$7.50**

SELENIUM CELLS

98–140 SELENIUM CELL, exposed surface, 17 mm. diameter, simple block mounting with binding posts. The scientific importance of the selenium cell has been recognized since the work of Bell and Ruhmer. It was not, however, until recently that its possibilities in the commercial field were fully realized. Many experimenters now agree that it is through the medium of the selenium cell that the "seeing" telephone may eventually become a reality. In our work with selenium we have discovered a most satisfactory method of attaching the material to the metal backing and improved methods of annealing are employed. The object has been to obtain a permanent surface and large area for the light to act upon and an area which will give as low initial electrical resistance as possible. This selenium cell is extremely sensitive to light, dropping in resistance many thousands of ohms when illuminated by a light of average intensity. Connected in series with a relay and battery, it will cause the relay circuit to be closed when the cell is illuminated. If a screen be interposed between the light and the cell, the relay circuit will be immediately opened. A telephone receiver connected in series with the selenium cell and a suitable battery will cause fluctuations in light to be detected. For example, the alternating current arc gives a tone depending upon the frequency of the current. Changes in the intensity of a direct current arc produced by superimposing on it a telephone current are audible **$17.00**



No. 98–141



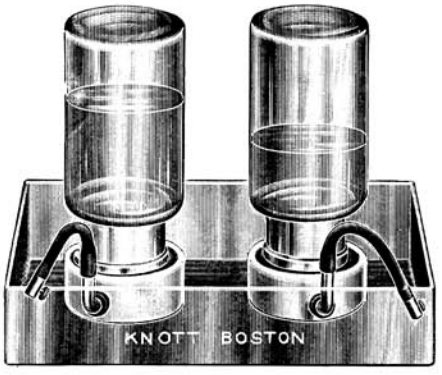
No. 98–142

98–141 SELENIUM CELL, exposed surface 44×19 mm., mounted in brass case as illustrated. Hard rubber light-proof cap supplied. Rod supplied for mounting on any convenient support or on **No. 98–145** Universally Adjustable Support which is recommended as the most useful and convenient support for the purpose **22.00**

98–142 MOUNTED SELENIUM CELL — Selenium Cell **No. 98–141** on Stand **No. 98–145** **26.25**

98–145 UNIVERSALLY ADJUSTABLE SUPPORT, designed especially for holding Selenium Cell **No. 98–141.** May be used to hold any apparatus on ¼-inch rod **4.25**

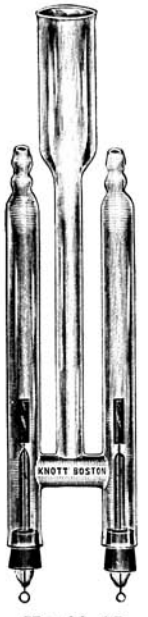
ELECTROLYSIS AND ELECTRO-CHEMISTRY



No. 99–5

99–5 PACKARD'S ELECTROLYSIS APPARATUS. We are indebted to Mr. John C. Packard of Brookline High School for this design. In simplicity of operation and cleanliness, it excels other apparatus designed for the same purpose. There are no parts which, when broken cannot readily be replaced. Consists of two special moulded porcelain bottle rests which are designed as electrode supports. These bottle and electrode supports can be used close together or apart to the limit of the glass tray. In use, the bottles and tray are filled with the electrolyte to a point covering the mouths. When current is connected, action immediately begins.

Complete as illustrated with glass tray **$4.50**

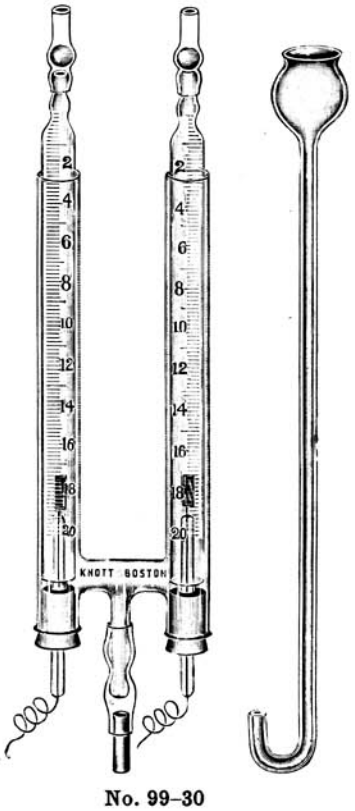


No. 99–15

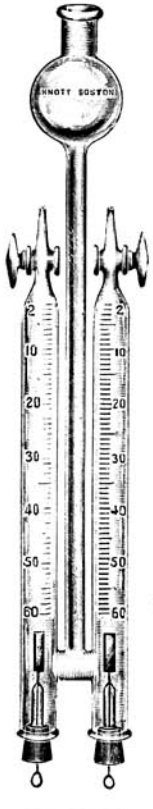
99–15 THE H-ELECTROLYSIS OF WATER APPARATUS. This is an improved type of electrolysis apparatus so designed that the platinum electrodes may easily be replaced by those of carbon or copper. In addition the reservoir tube is directly connected without bend to the junction tube of the gas tubes.

This type is ungraduated, and is for use with rubber tubing and pinch-cocks.

Complete with platinum electrodes **4.75**



No. 99–30



No. 99–20

99–20 THE HOFFMAN'S H-FORM ELECTROLYSIS OF WATER APPARATUS. This design has the same improvements as the one above. It, however, has graduated gas tubes provided with glass stop-cocks and the reservoir is globular shaped.

Complete with platinum electrodes **22.50**

99–30 OSBORNE'S IMPROVED ELECTROLYSIS APPARATUS. This design has the merit of efficient use in study of principles involved in electrolytic dissociations. It consists of an H-tube with graduated slide tubes, each with shot valve. By the improved construction of detachable electrodes the platinum electrodes may be readily replaced by those of carbon or copper as desired. With a glass stopper plug the apparatus is set up as a conductivity cell. In use for study of electrolysis of water the stopper plug is replaced by the bent end of the thistle tube.

Complete as illustrated **9.00**

99–50 **CARBON ELECTRODES,** for **Nos. 99–15** and **99–30** **$0.80**

99–52 ——, for **No. 99–20** **1.00**

99–55 **COPPER ELECTRODES,** for **Nos. 99–15** and **99–30** ..... **.80**

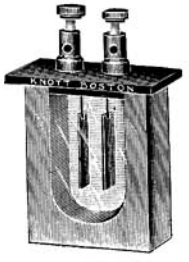
99–57 ——, for **No. 99–20** **1.00**

99–60 **PLATINUM ELECTRODES,** for **Nos. 99–15** and **99–30** **3.00**

99–62 ——, for **No. 99–20** **5.50**

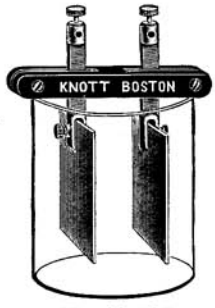
99–75 **ELECTROLYSIS TUBE SUPPORT,** stand with clamp and binding posts **4.75**

99–80 ——, smaller in size **3.40**



No. 99–100

No. 99–105



No. 99–195

99–100 **LANTERN ELECTROLYSIS DEMONSTRATION APPARATUS.** This design consists of a U shaped trough provided with a hard rubber cover with binding posts to which are connected the platinum electrodes. Will not leak and is not constructed with cumbersome compressor clamps **8.50**

99–105 **HYDROGEN ABSORPTION APPARATUS** (see Hall's "Elements of Physics," Paragraph 50), for showing the Power of Palladium to Absorb Hydrogen. Consists of a palladium and a platinum wire mounted parallel in a solid vulcanite frame. Binding posts supplied for connecting to a source of electric current. The frame is placed upright in a two per cent. solution of sulphuric acid and then an electric current, strong enough to decompose the solution, is connected to the binding posts. It will be noted that there is a visible flow of oxygen bubbles from the platinum wire, but no hydrogen bubbles from the palladium wire. Palladium, when cold, absorbs several hundred times its own bulk of hydrogen. Without beaker **12.00**

MATERIAL FOR ELECTROPLATING

99–110 **SILVER ANODE,** sheet form **$1.90**

99–115 **NICKEL ANODE,** sheet form ..... **.85**

99–120 **COPPER ANODE,** sheet form ..... **.30**

Ammonium Hydroxide	Per lb.	**$0.50**	**Potassium Cyanide**	Per lb.	**2.25**
Ammonium Hydroxide	Per 4 lbs.	**1.25**	**Pumice, powdered**	Per lb.	**.30**
Copper Sulphate	Per lb.	**.20**	**Rouge**	Per lb.	**.75**
Emery, powdered	Per lb.	**.25**	**Silver Chloride**	Per oz.	**1.35**
Nickel and Ammonium Sulphate	Per lb.	**.65**	**Tripoli**	Per lb.	**.25**

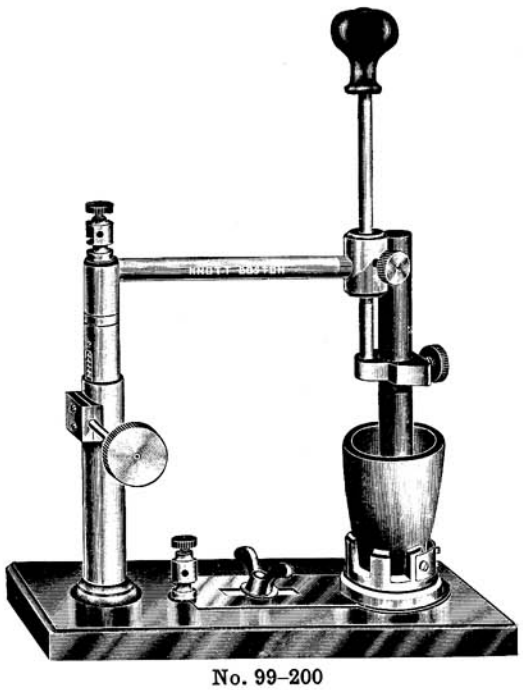
99–125 **ROUGE CLOTH,** especially prepared ..... **.60**

99–130 **CHAMOIS SKIN** ..... **.75**

99–170 **ELECTROTYPING LETTERS** (see National Physics Direction Sheets, Exp. E163, also Fuller & Brownlee, Exp. 71). Set of nine letters ..... **.50**

99–195 **ELECTROPLATING OUTFIT FOR COPPER PLATING,** consisting of jar, special clamp castings, insulating support for same, two copper electrodes, chemicals and complete directions for copper plating **2.00**

99–197 **COPPER VOLTAMMETER (COULOMBMETER)** similar in construction to **No. 99–195** Copper Plating Outfit, but changed and improved in design to suspend three copper plates — two loss plates and one gain plate. Note that the construction of the clamping device is such that the plates may be handled without touching them with the fingers. Complete with jar **5.80**

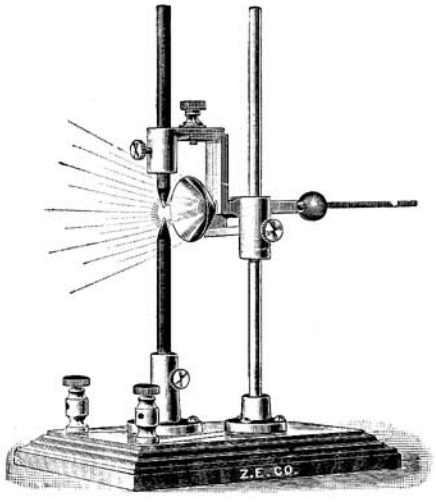


No. 99–200

99–200 SIMPLE ELECTRIC FURNACE. A simple practical form of electric furnace that will be found of great utility in the teaching of the electric arc, electric furnace, as well as the melting and combining properties of many elements. The construction enables a clear understanding of the many principles involved. Its open construction has great pedagogic value.

A great variety of experiments may be conveniently performed — the melting of platinum or like refractory metals, the reduction or production of aluminum or carbides. The manufacture of calcium carbide from lime and sawdust or carbon makes a striking and interesting experiment.

Complete ready for use..... $58.00



No. 99–350

99–350 DEMONSTRATION ARC LAMP WITH REFLECTOR for use with any strong source of battery current, but excellent for use with our **No. 97–148** Gear-Drive Hand-Power Dynamo in demonstrating the principle of arc lamps. It is a near approach to the automatic form, adjustment by counterpoise gravity feed. Quite simple in form and of open construction throughout. A simple reflector attached adds greatly to the effectiveness of the design. Complete as illustrated..... 9.25

TOOLS

We list below various tools which will be found of service in the laboratory.

200–10	**AUGUR BITS,** set of thirteen, from ¼ to 1 inch	$5.00
200–15	**BIT BRACE**	2.00
200–20	**BLOCK PLANE,** of iron, 5½ inches long	1.60
200–22	**BREAST DRILL.** Chuck has three jaws which hold round shanked bits from 0 to ½ inch. Drive wheel 5 inches diameter. Gearing changeable three to one. Crank adjustable, permitting variation in length of 3½ inches. A first-grade tool throughout	6.50
200–25	**CHISEL,** best Sheffield steel, one inch wide	.50
200–30	**CLAW HAMMER** fine quality of cast steel, weight one pound	1.50
200–40	**COLD CHISEL,** ½ inch	.40
200–50	**FILE,** flat, 8 inches long	.35
200–55	**FILE,** half round, 8 inches long	.35
200–60	**FILE,** round, 8 inches long	.30
200–62	**FILE,** triangular, 8 inches long	.30
200–65	**GIMLET,** large size, 5 inches long	.20
200–70	**HACK SAW,** consisting of malleable steel frame and saw blade	.90
200–75	**HACK SAW BLADES,** 8 inch, to fit the above frame. Per dozen	1.00
200–77	**HATCHET, STEEL CLAW,** best forged steel, highly polished blade, bronze finish	2.00
200–78	**NIPPER,** end cutting, length 6 inches	1.50
6248	**OIL STONE,** in wooden box, 7 inches long	.75
200–82	**PITCH GAUGE, "V"** threads, 22 pitches — 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72 and 74 threads per inch	1.75
6385	**PLIERS,** with side cutting blade, 5 inches	.85
200–86	**PLIERS, COMBINATION SLIP JOINT,** best forged steel, natural finish, polished jaws, length 6½ inches Each	.95
200–88	**PUNCH, SPRING,** cast steel, first quality, full polished	.75
200–90	**SAW, CROSS-CUT,** 26 inches long	3.25
200–95	**SAW, RIP,** 26 inches long	3.25
200–100	**SAW, KEY-HOLE**	1.00
200–105	**SCREW DRIVER,** instrument size, with small sharp blade	.35
200–110	**SCREW DRIVER,** heavy, 8 inch	.75
6524	**SHEARS,** metal cutting, 2½ inch blade	3.00
200–116	**TAP AND DIE SET.** Complete with stock round tap wrench, seven adjustable dies and seven taps cutting the standard threads used in the manufacture of our apparatus: 2/56, 4/32, 6/32, 8/32, 10/32, 12/34 and 14/24. In polished hardwood case	10.00
200–117	**TOOL CABINET for wall.** Contains 18-inch panel saw, smoothing plane, half hatchet, nail hammer, bit brace, ⅜ and ½-inch bits, 5-inch butt chisel, scraper, awl and tool set, 6-inch flat-nose plier, 2/32-inch nail set, 6-inch try square, folding boxwood rule, marking gauge, 4/36-inch gimlet bit, 8-inch mill file with handle, oil stone, carpenter's pencil, oil can, can of glue, 2 sheets of sandpaper, spool of wire, assorted screws, nails, brads and tacks. All tools of the highest grade of steel. Solid oak cabinet 24×16×6 inches deep, doors panelled, antique finish, varnished and hand rubbed, with brass padlock with two keys	65.00
200–118	**TOOL HOLDER,** hollow polished cocobolo handle, containing the following tools warranted the highest grade of steel: two sizes firmer chisels, gouge, three sizes of screw drivers, gimlet, keyhole saw, scriber, reamer, finely finished throughout	3.50
200–119	——, similar to above but smaller and containing ten tools, as commonly supplied	1.50
200–120	**WRENCH (MONKEY WRENCH),** 8 inches long	1.25

FIRST-AID CABINET

200–150	**Every science laboratory should be equipped to render first aid in treating cuts and burns.** That we may adequately meet this need, we have made up a first-aid cabinet containing both gauze and cotton bandages, styptic and surgical gauze, court plaster, pins and the ordinary condiments required to stop bleeding and for the proper treatment of burns, as well as for first-aid treatment in case of poisoning. Cabinet filled complete	$5.25

NATIONAL LOOSE-LEAF NOTE-BOOKS

BIOLOGY — CHEMISTRY

By Arthur S. Dewing, Ph.D.

The effort has been made to prepare these laboratory instructions in a manner to give students only such assistance as will enable them to observe and think for themselves. The author has avoided most carefully the "Verification Method" of teaching science by which the student is told exactly what he is to find or what conclusion to draw. The pupil is guided right to follow an individual channel in constructive observation and from a suggested sequence of thought learns to observe accurately and think clearly.

The Loose-Leaf System has long been recognized as one that affords the greatest latitude for choice and one that is best adapted to individual requirements. A teacher is enabled to select, from a series of experiments greater than required, the experiments adapted particularly to individual conditions. One may select a series adapted to meet State requirements, local educational requirements, etc. We have endeavored to keep in file courses of laboratory instruction satisfactorily meeting in actual use the many requirements. We should be pleased, therefore, to send, upon request, a note-book containing a series of direction sheets in Chemistry, Biology or Physics, outlining a course found entirely adequate in meeting similar requirements. Such service is entirely gratis.

NATIONAL BIOLOGY DIRECTION SHEETS

This series covers Botany, Zoology and Physiology, 118 sheets. A number of these direction sheets are in the nature of introductory exercises concerning the general nature of organisms and their simple chemical processes and they should, when possible, precede the work in any of the special exercises. Larger amounts of matter are given in every case than can ordinarily be undertaken, the author believing that a variety of conditions requires a variety of methods and subjects.

A FEW NOTES AND COMMENTS

Wallace, Idaho, Independent School District No. 8.
"I believe the use of your books will do more to standardize science work than anything else; at the same time they allow for a teacher's preference and originality by providing a choice of sheets. As I am myself using the Biology Set, I shall make quite a point of that to illustrate the system."

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"I find the Note-Book very interesting and full of practical usefulness."

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"I am using he Note-Book in my class and find it most satisfactory."

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"I have been using your National Note-Books in Botany and Physics this year, and wish to express to you my complete satisfaction in regard to same. This has been my idea of a note-book for many years, but have never before found one so well selected and arranged, so reasonable in price and so neatly put up and constructed, as the ones secured from you."
"They are the best I know of and shall not only use them myself, but expect to speak of them to all who teach science, with whom I come in contact."

Dryden, N. Y., High School.
"The sheets of the National Biology Note-book are in use in this school and I am glad to say that they are a great help in that subject. We also use the National Physics Note-Book and find it very practicable. I thank you for your interest and your attempt to supply so many good things that schools want."

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"I have examined with interest the Loose-Leaf Note-Book for B ology which you sent us. It seems to be an excellent plan. There has been a very wise selection of the essentials. I shall take pleasure in recommending this to teachers."

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The National Chemistry Direction Sheets were prepared to meet several demands. In the first place the experiments, exercises, and descriptive matter, when taken together, and in the order indicated by the Index, supply a clearly defined method for teaching Chemistry. Its spirit is to develop the powers of observation and inference. The series covers 145 sheets from which number the teacher is enabled to select a course adapted to individual need.

A FEW NOTES AND COMMENTS

Boston, Mass., Noble & Greenough's Classical School.
"The work done in my Chemistry class this year has been much simplified by the use of your Chemistry Loose-Leaf Notes. With a proper amount of selection of the notes I find I have been able to accomplish the laboratory work in less time than usual and, I think, with more satisfactory results."

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"I believe that by a proper use of the Notes, a good course could be given in any school, using specially adapted experiments and your notes in place of any regular text."

Albany, N. Y., State Normal College.
"You are at liberty to use anything that I have written commendatory of the Loose-Leaf Note-Books. I think they are the ideal plan for teaching Chemistry in the laboratory, and when accompanied by efficient supervision of the students at work, by study from a well-digested text-book, and by discussion in the classroom, and all summed up by the teacher in a weekly lecture with demonstrative experiments, the course could not, in my opinion, be surpassed."

Cincinnati, Ohio, St. Xavier College.
"The National Chemistry Note-Book has proved, in practise, to be all I expected it would be. The questions, observations, and exercises are very suggestive, and stimulate to thought and attention. They are well chosen, I believe, to develop a mental attitude of scientific inquiry in the pupil."

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"I find both the Chemistry and Physics Sheets the most complete and most satisfactory that I have ever seen. You may expect future orders from our school."

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CERTIFICATION SHEETS.....
HARCOURT BINDERS, cloth backs, with binding cord, for holding National Loose-Leaf Sheets

Write for Price List.

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Alundum is fused aluminum oxide. When bonded with ceramic materials and given proper heat treatment refractory articles can be obtained that have many desirable properties. Pure alundum, which is more than 99 per cent. aluminum oxide, melts at 2050°C. and the bonded shapes at temperatures somewhat less than this, depending on the character of the mixtures.

Alundum is a very inert substance and the bonded articles are not readily attacked by chemically active solutions.

Alundum is a poor conductor of electricity and is, therefore, particularly valuable in electrical constructions.

Alundum articles listed in this catalogue are carried in stock for immediate shipment. Muffles, other articles, and special pieces can be obtained. Correspondence regarding special needs is solicited.

"PYREX" GLASSWARE

Our stock of "Pyrex" glassware, as listed through this catalogue, is complete. We offer it as resistance ware comparable with Jena glassware that cannot now be obtained.

"Pyrex" Glass contains no heavy metals of the magnesium-lime-zinc group.

"Pyrex" Glass does not soften below 800°C. and a rod heated to 300° C. and then plunged into cold water will not break.

"Pyrex" Glass has a very low expansion coefficient of 0.0000032 (porcelain has an expansion coefficient of 0.0000036), allowing the construction with heavy walls, thus greatly increasing the durability of the vessels.

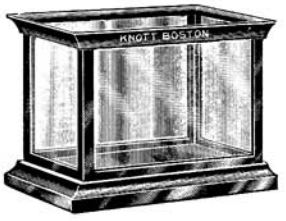
FUSED SILICA WARE

On account of the high cost of platinum, the various laboratory vessels and utensils of Fused Silica listed in this catalogue may profitably receive the careful consideration of every chemist.

Its unusual properties are:

1. A melting point above 1500° C.
2. An extremely small coefficient of expansion — 0.00000059 (about 1/17th that of glass).
3. It is not attacked by acids.
4. It is absolutely constant in weight.
5. It is insoluble in water.

No. 3502



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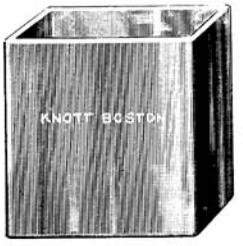

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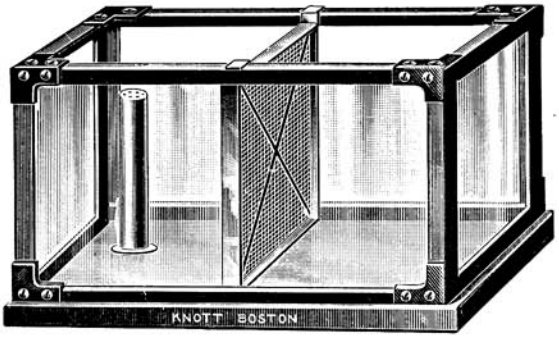


No. 3527

No. 3520

3500 **AIR TESTER, DEWING'S,** for testing the amount of CO_2 in the air (see National Biology Note-Book Sheets, Exp. P51). Complete with lime water, phenolphthalein, pipette, graduated flask, graduated cylinder, graduated tube and plunger, with full directions **$4.75**

3502 **AIR TESTER,** after Dr. G. W. Fitz, for the accurate determination of CO_2. Consists of a carefully graduated instrument, set of storage vials, graduated flask, graduated pipette and full set of directions. A most satisfactory piece of apparatus for an accurate determination of the amount of CO_2 in a room. With reagents, in neat board case **4.50**

3504A **PHENOLPHTHALEIN SOLUTION.** Quantity sufficient for 100 tests **1.25**

3504B **LIME WATER.** Quantity sufficient for 100 tests ..... **.50**

5435g **GRADUATED FLASK,** 100 cc., for above apparatus ..... **.55**

6313a **GRADUATED PIPETTE,** 1 cc., for above apparatus ..... **.20**

6313e **GRADUATED PIPETTE,** 10 cc., for above apparatus ..... **.25**

3505 **SOLID ALCOHOL** for use in the can as an alcohol stove. This alcohol is a patented product moulded in solid form in a slip cover can. Capacity of can 3½ ounces. Will burn continuously from one to one and one-half hours ..... **.15**

3510 **ALUNDUM,** 60 mesh, for protecting the bottoms of Alundum combustion boats from the slagging effect of the iron oxide during the combustion of the sample ..... Per lb. bottle **1.25**

3512 **ALUNDUM CEMENT,** superior to other mixtures for covering wire resistors in many kinds of high temperature electrical apparatus and appliances ..... Per lb. bag **.35**

3515 **APRON,** chemical and water-proof, 48 inches long, 36 inches wide, readily adjusted to both sexes ... **1.65**

6268 **OVERSLEEVES,** chemical and waterproof, ample size, readily adjusted to both sexes ..... Per pair **.50**

3520 **AQUARIA JARS, ROUND,** heavy colorless glass.

	a	b	c
Capacity, quarts	2	4	8
Size, inches	6×6	7×7	9×9
Each	**$1.60**	**2.40**	**3.50**

3522 **AQUARIUM JAR, RECTANGULAR,** heavy colorless glass, capacity 2½ gallons, 10½ inches long, 6½ inches wide, 10½ inches high **7.50**

3525a **AQUARIUM, Enameled Metal Frame,** glass bottom and sides. Length, 12 inches; width, 8 inches; height, 7 inches. Capacity 2½ gallons **4.80**

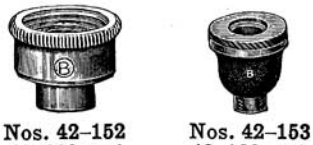
3525b ——, length, 15 inches, width, 10 inches; height, 9 inches. Capacity, 5 gallons **6.00**

3525c ——, length, 18 inches; width, 12 inches; height, 11 inches. Capacity, 7 gallons **8.40**

3525d ——, length, 21 inches; width, 14 inches; height, 13 inches. Capacity, 12 gallons **11.00**

3527 **AQUARIUM TANK, with iron frame work and stone base.** This aquarium must not be confused with those where the light is blocked from the ends by stone slabs. Our tank has **heavy plate glass in all four sides,** these glass plates being held by substantial iron frames locked at the corners by iron castings. The base is of alberene stone 1¼ inches thick. In sealing the plates water-tight, we use a cement which we compound in our laboratories and which we guarantee will not leak nor soften by action of water. Alberene stone base measures 32½×21 inches. Dimensions of tank, outside, 30½×19×16½ inches deep. Complete with standing overflow and brass gauze separating partition. **75.00**

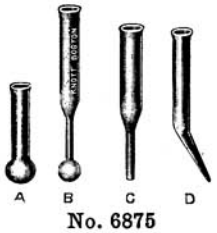
3528 **SUPPORTING AQUARIUM TABLE.** We have frequently supplied a table support for the above aquarium. This table is built of solid oak with acid proofed built-up maple top. It is equipped with one drawer and further provided with a special long goose-neck water supply faucet. F.O.B. factory **55.00**



Nos. 42–152
42–162 and
42–177

Nos. 42–153
42–163 and
42–178

No. 3530



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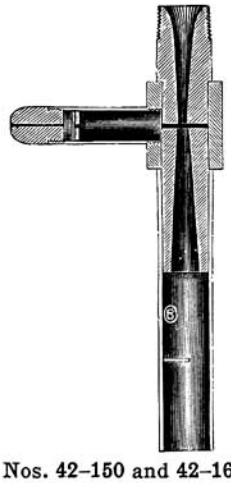

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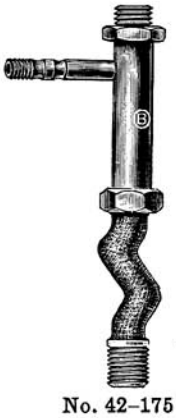

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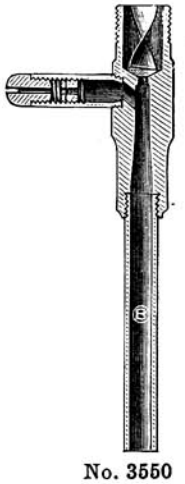


No. 3550

3530 **ARSENIC TEST APPARATUS** after Gutzeit, for analysis for arsenic in foods. Will indicate 0.001 mg. of arsenious oxide by a yellow stain on a sensitized paper strip. With full directions; without test strips **$1.75**

3530A **ARSENIC TEST STRIPS,** unsensitized ..... Per 1,000 **1.50**

6875 **ARSENIC TUBES,** hard glass.

	a	b	c	d
Each	**$0.10**	**.10**	**.10**	**.10**
Set of four				**.35**

ASBESTOS

Asbestos is fire and acid-proof and is, therefore, particularly adapted for use in science laboratories.

3540 **ASBESTOS BOARD,** 40×40 inches.

	a	b	c	d
Thickness, inch	1/32	1/16	3/32	$\frac{3}{16}$
Per sheet	**$0.75**	**1.40**	**2.00**	**3.50**

3541 **ASBESTOS BOARDS,** 3/32 inch thick.

	a	b	c
Size, inches	4×4	6×6	12×12
Each	**$0.06**	**.08**	**.35**

3543 **ASBESTOS BOARDS,** 1/32 inch thick.

	a	b
Size, inches	4×4	6×6
Each	**$0.05**	**.06**

3545 **ASBESTOS WOOL,** long selected fibre. Per 4-ounce package, **$1.50** ..... Per lb. **$5.50**

ASPIRATORS

42–150 **ASPIRATOR, CHAPMAN'S,** of brass, 3¾ inches long, ⅛ inch I. P. size thread, capacity 5 cubic feet per hour **$2.00**

42–152 **HYDRANT COUPLING** for attaching above aspirator to a ¾-inch hose bib or faucet ..... **.45**

42–153 ——, for attaching above aspirator to a smooth faucet. This coupling cannot leak or be forced off ... **.65**

42–160 **ASPIRATOR, CHAPMAN'S,** of brass, 4¾ inches long, ¼-inch I. P. size thread, capacity 18 cubic feet per hour **2.15**

42–162 **HYDRANT COUPLING** for attaching above aspirator to a ¾-inch hose bib or faucet ..... **.45**

42–163 ——, for attaching above aspirator to a smooth faucet. This coupling cannot leak or be forced off **.65**

42–175 **ASPIRATOR, RICHARDS',** of brass, very powerful, 7 inches long, ⅜-inch I. P. size thread **3.00**

42–177 **HYDRANT COUPLING** for attaching above aspirator to a ¾-inch hose bib or faucet ..... **.45**

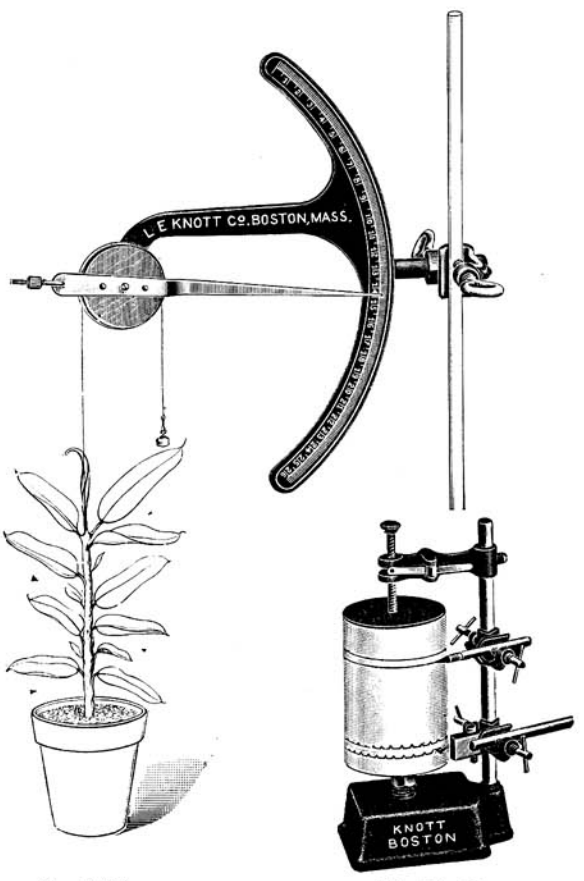
42–178 ——, for attaching above aspirator to a smooth faucet. This coupling cannot leak or be forced off ..... **.65**

3550 **ASPIRATOR, HIGH VACUUM,** more powerful than preceding and uses less water, ¼-inch I. P. size thread. Length, 4¾ inches **2.25**

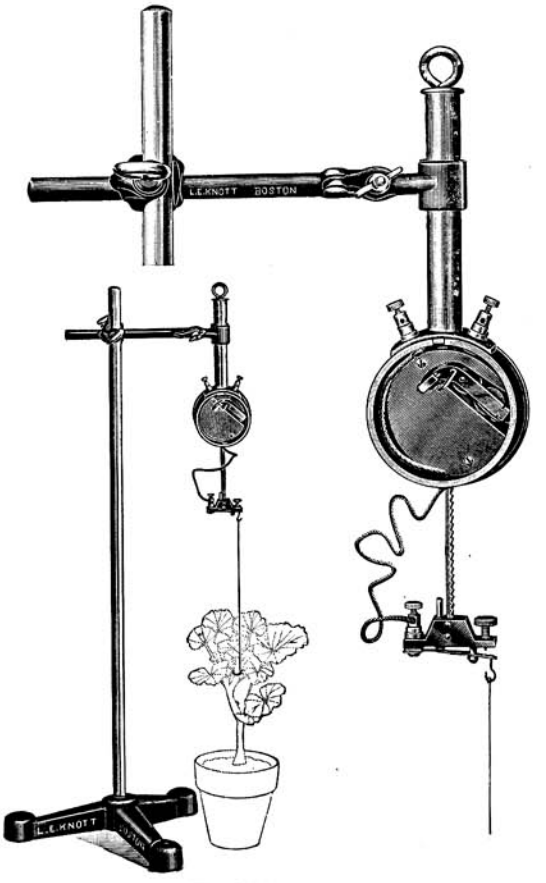
3555 **AUTOCLAVE, Steam Pressure Sterilizer or Cooker,** 17-quart, of cast aluminum for sterilization or digestion under pressure. Useful in domestic science laboratories for cooking or canning foods; or in biological, bacteriological and pathological laboratories, for sterilizing. Pressure gauge reads to 30 lbs. With safety valve and pet cock.

Inside diameter, 11½ inches; inside length, 10½ inches; weight, approximately 17 lbs. **37.50**

No. 3555



No. 3560 No. 54–40



No. 3563

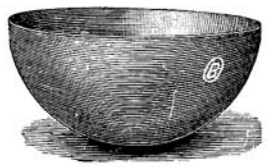
3560 HARCOURT STUDENTS' AUXANOMETER. This instrument is not intended for precision work, but will be found most satisfactory in measuring the growth of plants with a reasonable degree of accuracy and sensibility. The apparatus as shown in the illustration is used on the regulation support stand and plant growth is indicated by movement of a pointer over a graduated arc. Without support stand..... **$3.80**

3563 BOVIE PRECISION AUXANOMETER, an invention by Dr. W. T. Bovie of Harvard University, for recording the growth of plants. For classroom or out-of-door use. Will indicate growth by as small as 0.1 mm.

The Bovie Precision Auxanometer consists essentially of a device which is carried upward as the plant grows. When the device has moved a certain distance, it closes an electric circuit which operates the recording pen of the chronograph. This arrangement makes it possible to have the recording mechanism at any desired distance from the plant and to make simultaneous records of a number of plants or of various parts of the same plant. The instrument is light, compact and quickly set up for use and, as the force of gravity is not utilized for moving any of its parts, it may be set at any angle with the vertical so that growth in any direction may be measured and recorded. Records of each 0.1 mm. of growth can be made and the instrument will be found reliable in or out-of-doors. The experimental model was run by Professor Bovie the entire summer in the garden exposed to the weather, the brass case being open part of the time so that the internal mechanism was exposed.

Complete specifications furnished upon request. Furnished in plush-lined polished hardwood box with hinged cover..... **48.50**

54–40 CLOCK RECORDING KYMOGRAPH. This instrument was designed, at the request of Dr. Bovie of Harvard University, to provide a simple, easily manipulated, effective device for recording the curve of plant growth in conjunction with the Bovie Auxanometer. The recording mechanism, whether it be a pencil or electrical pen, is readily clamped to the supporting upright as indicated in the illustration. The clock mechanism mounted in the base is a standard 24-hour clock movement of heavy construction. The cylinder is raised to the upper position by simply releasing the compression clamp and lifting the cylinder bodily The range of movement and the length of the cylinder is such as to permit three or four records being made at one time. This is made possible because of the position in which the cylinder is mounted, the weight of the cylinder assisting rather than retarding the clock movement. Complete with 24-hour movement..... **27.50**



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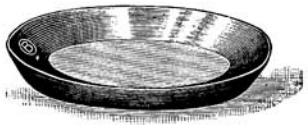

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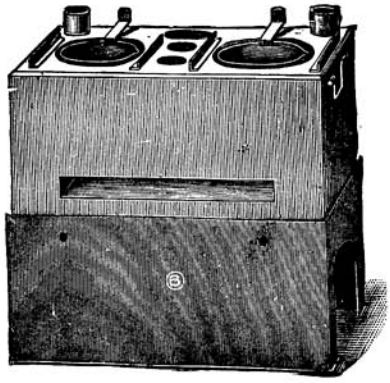

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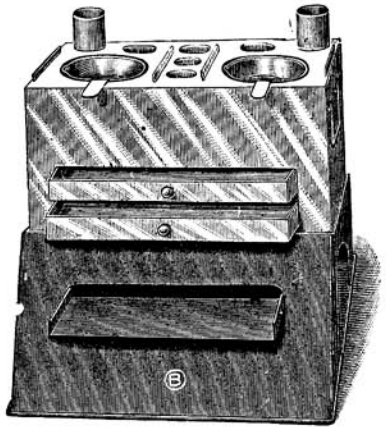

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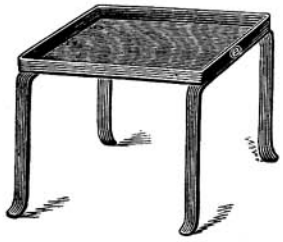


No. 3575

No. 3577

3568 BATH, SAND, SHALLOW, of asbestos, diameter 6 inches **$0.40**

3570 BATHS, SAND, DEEP HEMISPHERICAL, of sheet iron.

	a	b	c	d
Diameter, inches	3	4	6	8
Each	$0.12	.16	.30	.50

3572 BATHS, SAND, SHALLOW, of sheet iron.

	a	b	c	d
Diameter, inches	3	4	6	8
Each	$0.12	.14	.25	.45

3575 BATH, SAND or HOT PLATE. Measures 6×8 inches. On legs **2.75**

3577 BATH, SAND or HOT PLATE, RUEDORFF'S with ATTACHED BURNER. Of cast iron. Measures 11×17½ inches; with three rows of burners that are adjustable in height **23.50**

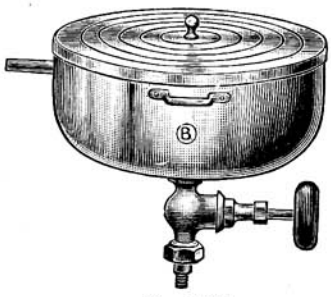
3579 PARAFFINE BATH, POLISHED COPPER, with tubulatures for thermometer, gas regulator and three test tubes. Dimensions, 7 inches long, 3¾ inches wide and 3½ inches deep. With extra sheet iron bottom and iron base which is 5 inches high. Provided with a space for heating slides and two nickel-plated cups. The shallow cup is 2⅛ inches diameter, ¾ inch deep, watch glass shape, and the deep one is 2½ inches diameter and 1½ inches deep **17.50**

3581 PARAFFINE BATH, MILLER'S POLISHED COPPER, with tubulatures for thermometer, gas regulator and five test tubes. Dimensions, 8 inches long, 4 inches wide and 4 inches deep, provided with an extra sheet iron bottom to prevent burning out; and iron base, 5 inches high. The bath has two nickel-plated cups, one shallow and one deep. The shallow cup is 2⅛ inches in diameter and ¾ inch deep, watch glass shape; and the deep one is 2⅛ inches diameter and 1½ inches deep. Two drawers are provided for holding slides **28.50**

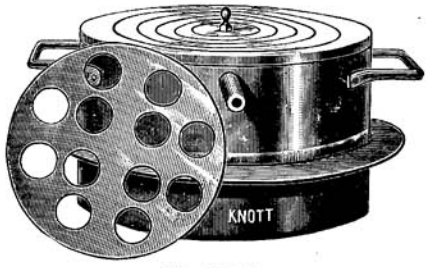
WATER BATHS

The water baths listed below are of polished copper, tin-lined, most carefully made throughout.

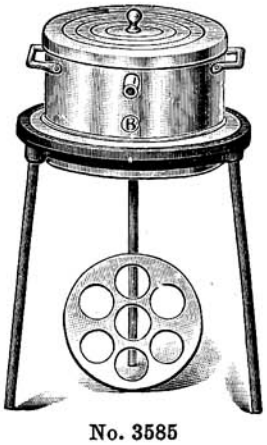
No. 3582



No. 3583



No. 3587



No. 3585

No. 3590

No. 3593

3582 WATER BATHS, POLISHED COPPER, tin-lined, with concentric rings and steam cover.

	a	b	c	d
Diameter, inches	5	6	8	10
No. of Rings	4	5	7	8
Each	**$2.00**	**2.75**	**4.50**	**8.00**

3583 WATER BATHS WITH STEAM VALVE, POLISHED COPPER, tin-lined, most excellent and economical.

	a	b	c
Diameter, inches	6	8	10
No. of Rings	5	7	8
Each	**$9.75**	**11.00**	**15.00**

3585 WATER BATHS, POLISHED COPPER, ON TRIPOD, tin-lined. Seamless body with concentric rings and cover, steam escape and extra plate perforated for test tubes.

	a	b	c
Diameter, inches	5	6	8
No. of Rings	4	5	7
Each	**$6.00**	**6.75**	**11.00**

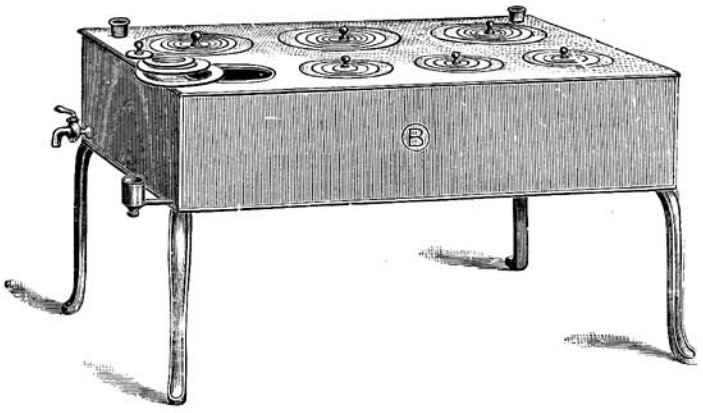
3587 WATER BATHS, POLISHED COPPER, tin-lined, seamless body, with concentric rings and cover, steam escape and extra plate perforated for test tubes.

	a	b	c
Diameter, inches	5	6	8
No. of Rings	4	5	7
Each	**$5.50**	**6.00**	**10.00**

3590 WATER BATHS, FUNNEL SHAPE, POLISHED COPPER, tin-lined. With concentric rings and constant water level. Height including tripod, 8 inches.

	a	b
Diameter, inches	6	8
No. of Rings	5	7
Each	**$7.00**	**10.00**

3593 WATER BATH, HOFFMAN'S, of heavy polished copper, with a set of concentric rings and plate with five holes of different sizes, each with cover. With constant-water level. Diameter at top, 8 inches **22.25**



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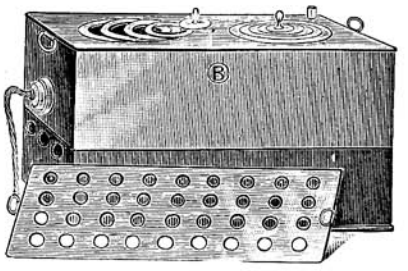

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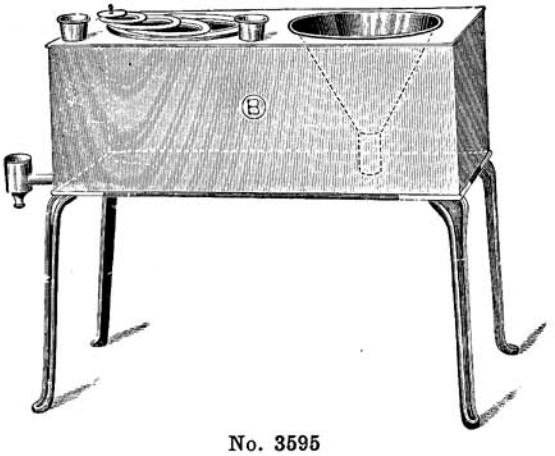

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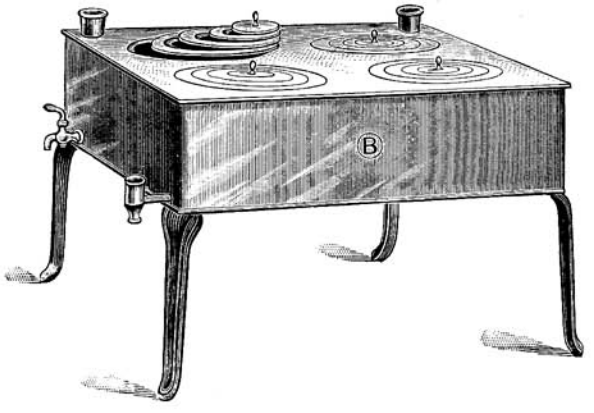
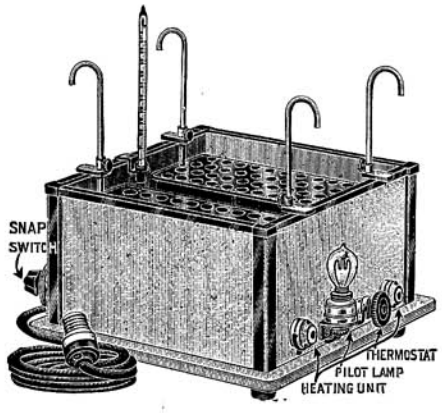


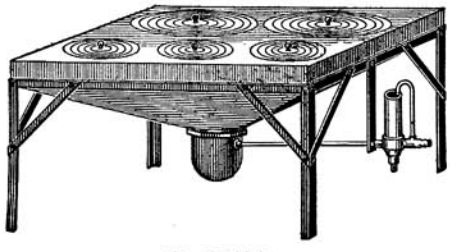
No. 3605

3595	**WATER BATH, GRIFFIN'S, POLISHED COPPER, tin-lined** for hot **filtrations** and **evaporations.** Provided with a constant water level, an extra sheet iron bottom and rests on four detachable legs. Size 13×7×5 inches deep. One 5-inch hole with four concentric rings and steam cover and one opening with copper funnel	$21.00
3600	**WATER BATH, ELECTRICALLY HEATED, POLISHED COPPER, tin-lined.** With two removable covers, one cover with two 5-inch openings and concentric rings, the other with 36 ⅞-inch holes for test tubes. Size 14½×6½×3 inches deep. Height over all 7½ inches. Provided with **automatic cut-out** that shuts off current if bath is allowed to run dry	49.50
3605	**WATER BATH, POLISHED COPPER, tin-lined,** with concentric rings and steam cover. Provided with stopcock and Kekule's Water Level Regulator. With extra sheet iron bottom, and supported by four detachable legs. Size 14×14×5 inches deep. Four openings, 5 inches in diameter, with rings and steam cover	22.50
3605A	——, **STEAM, POLISHED COPPER, tin-lined,** same as above, but arranged with coil to be heated by steam	30.00
3605B	——, **ELECTRIC, POLISHED COPPER, tin-lined,** same as above, but arranged for electrical heating	70.00
3607	**WATER BATH, POLISHED COPPER, tin-lined,** with concentric rings and cover, provided with stopcock and Kekule's Water Level Regulator. With extra sheet iron bottom supported by four detachable legs. Size 23×13½×5 inches deep. Seven openings, three of 6 inches diameter and four of 4 inches diameter with concentric rings and steam cover	34.00
3607A	——, **STEAM, POLISHED COPPER, tin-lined,** same as above, but arranged with coil to be heated by steam	45.00
3607B	——, **ELECTRIC, POLISHED COPPER, tin-lined,** same as above, but arranged for electrical heating	95.00
3610	**WATER BATH, POLISHED COPPER, tin-lined,** with concentric rings and steam cover. Provided with stopcock and Kekule's Water Level Regulator. With extra sheet iron bottom and supported by four detachable legs. Size 28×14×5 inches deep, eight openings 5 inches in diameter with rings and steam cover	42.50
3610A	——, **STEAM, POLISHED COPPER, tin-lined,** same as above, but arranged with coil to be heated by steam	55.00
3610B	——, **ELECTRIC, POLISHED COPPER, tin-lined,** same as above, but arranged for electrical heating	100.00



No. 3611

No. 3611A



No. 3612A

No. 3612B

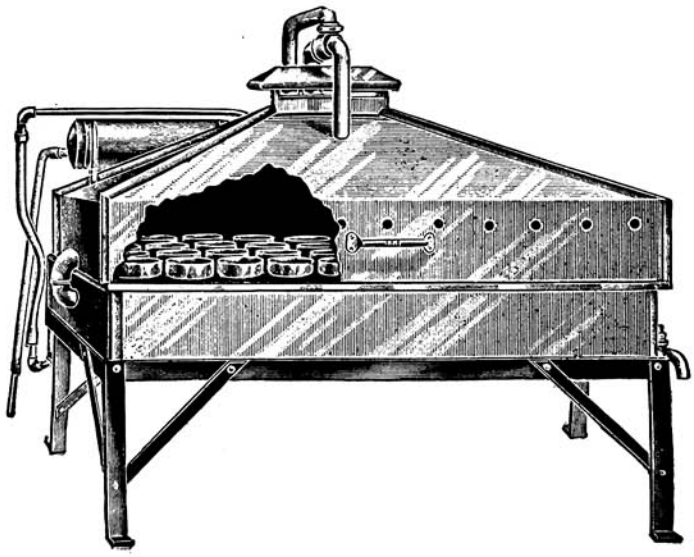
3611 **WATER BATH, ELECTRICALLY HEATED, CONSTANT TEMPERATURE.** Inside dimensions 9×9 inches by 5 inches deep. Made from heavy copper, tinned on the inside and covered on the outside with a thick insulating material to prevent radiation. The heating units are in metal tubes at the bottom of the bath and temperature is regulated by the pencil type of thermostat. A pilot lamp indicates when the current is on or off. A snap switch controls part of the heating units and temperature of the bath may be changed as desired from 37½ to 56° C.
Furnished with two Test Tube Racks **No. 3611A,** each rack having a capacity of 48 test tubes, 3×⅜ inches. Maximum current consumption 2¼ amperes..... **$72.50**

3611A **TEST TUBE RACK,** nickeled brass with adjustable supports for suspension in bath; with two shelves. Dimensions 9×4 inches by 2½ inches high. Height over all 8 inches. Capacity 48 test tubes, 3×⅜ inches..... **6.00**

3612 **WATER BATH, WILEY'S STANDARD.** This bath was devised to reduce the time used in getting up steam. The cup underneath holds the water and is the only part that is heated. A full head of steam evenly distributed can be obtained in three minutes to the point of supply which is 2¼ inches above the bottom. The cup contains 250 cc. and is fed by a ¼-inch copper pipe and is connected to a constant level regulator of the latest type. The bath is of heavy copper supported on a braced stand of 1-inch angle iron. Top measures 25×14½ inches. It contains 12 holes 3½ inches diameter and 2 holes 5¾ inches diameter, fitting the standard porcelain rings. The bath is 2 inches deep on the outside edge and slopes to 4 inches deep at the center.
Price with copper concentric rings..... **77.75**

3612A ——, same as above, but smaller. Top measures 14×12½ inches. There are 2 openings 5¾ inches diameter and 3 openings 3½ inches diameter. With copper concentric rings..... **55.00**

3612B ——, this bath has same patented features of **No. 3612,** but is round in form and is mounted on a stand of American Ingot iron, lined with heavy asbestos. Diameter of top, 12 inches. It has one hole 3½ inches diameter and 6 holes 2½ inches diameter, each fitted with concentric rings..... **29.00**



No. 3613

3613 **WATER BATH, ALSOP'S,** for evaporations, especially in tanners' laboratories. Made of heavy copper throughout, tinned inside, with polished brass fittings. It is mounted on a heavy angle iron stand. The condenser is mounted on the lid and the condensation may be used as distilled water. Size, 25 × 20 inches, for 60 crystallizing dishes 2¾ inches diameter **$260.00**

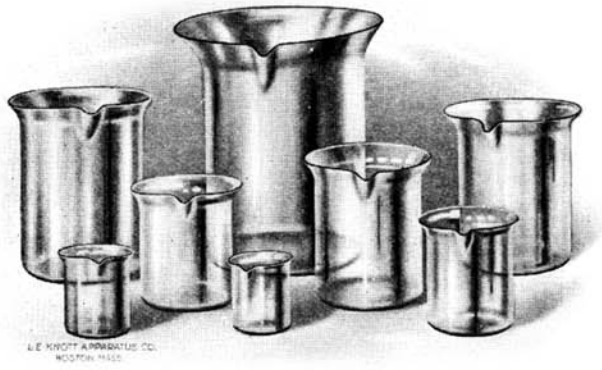
Extra for **Steam Heating** **15.00**

3613A ——, size, 35×25 inches, for 110 crystallizing dishes 2¾ inches in diameter **300.00**

Extra for **Steam Heating** **20.00**

3615 **GLASS BEADS,** hollow, for filtering and drying gases by means of acid ..... Per lb. **1.90**

BEAKERS



3625 BEAKERS, HARCOURT GLASS, low, wide Griffin form, with lip.

	a	b	c	d	e	f	g	h
No.	1	2	3	4	5	6	7	8
Capacity, cc.	90	120	250	350	500	600	750	1000
Each	**$0.14**	**.15**	**.18**	**.22**	**.26**	**.28**	**.33**	**.40**

3626 BEAKERS, HARCOURT GLASS, same as above, but nested as follows:

	a	b	c	d	e	f
No. in Nest	3	4	5	6	7	8
Size Nos.	1–3	2–5	1–5	1–6	1–7	1–8
Capacity, cc.	90–250	120–500	90–500	90–600	90–750	90–1000
Per Nest	**$0.47**	**.81**	**.95**	**1.23**	**1.56**	**1.96**

3628 BEAKERS, "PYREX" GLASS. (See index, **"Pyrex" Glassware** for characteristics.) Griffin low form, with lip.

	a	b	c	d	e	f	g	h	i	j	k	l	m	n
Capacity,cc.	50	100	150	250	400	600	800	1000	1300	1500	2000	2500	3000	4000
Each	**$0.20**	**.21**	**.24**	**.28**	**.33**	**.39**	**.45**	**.60**	**.72**	**.82**	**1.10**	**1.35**	**1.56**	**2.00**

3629 BEAKERS, "PYREX" GLASS, same as above, but nested as follows:

	a	b	c	d	e	f
No. in Nest	3	4	5	6	7	8
Capacity, cc.	50–150	50–250	50–400	50–600	50–800	50–1000
Per Nest	**$0.65**	**.93**	**1.26**	**1.65**	**2.10**	**2.70**

3631 BEAKERS, HARCOURT GLASS, usual form, without lip.

	a	b	c	d	e	f	g	h
Size No.	1	2	3	4	5	6	7	8
Capacity, cc.	90	120	250	350	500	600	750	1000
Each	**$0.14**	**.15**	**.18**	**.22**	**.26**	**.28**	**.33**	**.40**

3632 BEAKERS, HARCOURT GLASS, same as above, but nested as follows:

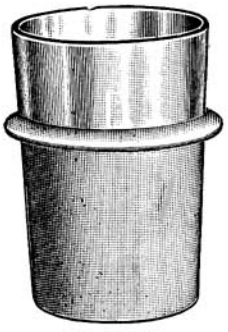
	a	b	c	d	e	f
No. in Nest	3	4	5	6	7	8
Size Nos.	1–3	2–5	1–5	1–6	1–7	1–8
Capacity. cc.	90–250	120–500	90–500	90–600	90–750	90–1000
Per Nest	**$0.47**	**.81**	**.95**	**1.23**	**1.56**	**1.96**

3634 BEAKERS, "PYREX" GLASS (see index **"Pyrex" Glassware** for characteristics) usual form, without lip.

	a	b	c	d	e	f	g	h	i
Capacity, cc.	100	150	200	300	400	500	600	800	1000
Each	**$0.21**	**.23**	**.26**	**.30**	**.33**	**.35**	**.40**	**.42**	**.60**

3635 BEAKERS, "PYREX" GLASS, same as above, but nested as follows:

	a	b	c	d	e	f	g
No. in Nest	3	4	5	6	7	8	9
Capacity, cc.	100–200	100–300	100–400	100–500	100–600	100–800	100–1000
Per Nest	**$0.70**	**1.00**	**1.33**	**1.68**	**2.08**	**2.50**	**3.10**



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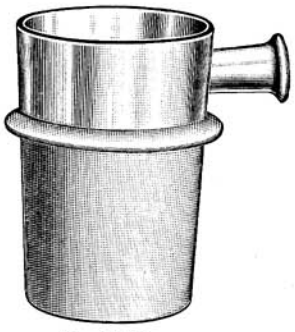

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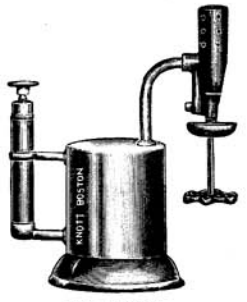


No. 3687

3638 BEAKERS, ALUMINUM, Griffin form, with lip.

	a	b	c
Capacity, cc.	250	500	1000
Each	**$0.95**	**1.55**	**2.10**

3640 BEAKERS, SPUN COPPER, polished, Griffin form, with lip.

	a	b	c
Capacity, cc.	250	500	1000
Each	**$1.20**	**1.75**	**2.40**

3643a BEAKER (DYE POT), "PYREX" GLASS. (See index, **"Pyrex" Glassware,** for characteristics.) Heavy wall, without lip, capacity 400 cc. **$0.67**

3643b ——, capacity 600 cc. **.78**

3645 BEAKERS, PORCELAIN, without lip, glazed inside and outside, extensively used in testing of dye stuffs, etc.

	a	b	c
Capacity, cc.	340	580	970
Height, mm.	118	143	167
Diameter, mm.	65	78	93
Each	**$1.33**	**1.59**	**2.39**

3646 BEAKERS (DYE POTS), PORCELAIN, without lip, superior quality. Diameter, 86 mm.; diameter below flange, 87 mm.; height, 128 mm. Capacity, 290 cc. **1.59**

3646A ——, same as above, but diameter, 127 mm.; diameter below flange, 115 mm.; height, 184 mm. Capacity, 1125 cc. **3.63**

3647 BEAKERS (DYE POTS), PORCELAIN, without lip. Superior quality, with socket for wooden handle. Diameter at top, 86 mm.; diameter below flange, 80 mm.; height, 128 mm. Capacity, 290 cc. **3.20**

3647A ——, same as above, but diameter at top, 96 mm.; diameter below flange, 118 mm.; height, 136 mm. Capacity, 425 cc. **4.35**

3650 BEAKERS, FUSED SILICA. (See index, **"Fused Silica Ware,"** for characteristics.) With lip.

	a	b	c	d	e	f	g	h	i
Capacity, cc.	50	100	150	200	250	400	500	600	800
Each	**$2.75**	**3.05**	**3.40**	**3.65**	**4.40**	**5.15**	**5.90**	**6.60**	**8.00**

BIRDS BIOLOGY AND NATURE STUDY

No. 3675

We have made arrangements with a leading taxidermist so that we carry the following:

3660 COLLECTION OF MOUNTED BIRDS FOR SCHOOL USE. Contains thirty of our common species representing the common orders. It includes *Grebe, Tern, Teal, *Heron, Rail, *Sandpiper, *Hawk, Owl, Kingfisher, *Woodpecker, *Kingbird, Phoebe, *Bluejay, *Crow, Cowbird, *Blackbird, Meadow Lark, Goldfinch, Native and English *Sparrow, Towhee, Scarlet Tanager, *Barn-Swallow, Red-Eyed Vireo, *Common Warbler, Catbird, House Wren, Chickadee, *American Robin, *Bluebird. **$95.00**

3661 SKINS of the above, unmounted. **60.00**

3663 FIFTEEN COMMON SPECIES representing those starred in above list. **55.00**

3664 SKINS, unmounted, those starred in above list. **40.00**

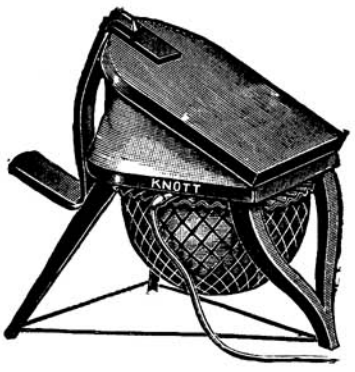
3666 COLLECTION OF EGGS, corresponding to collection **No. 3660** (in a few cases not identical with it in species). **7.40**

3667 COLLECTION OF EGGS, representing those starred in above list. **4.25**

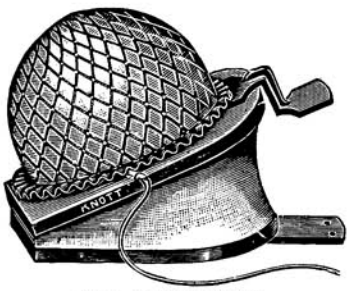
3675 BLAST APPARATUS, RICHARDS', for use where water pressure is available, in obtaining either blast or vacuum. Desirable for quick filtering and operating blast lamp. Complete with one aspirator. **17.50**

3685 BLAST LAMP, GASOLINE, ¼-pint capacity, giving a small hot flame, generating its own gas. With holder with cork-lined cap on side of the body for holding cleaner wire and nozzle when not in use. Will burn constantly for about three hours with one filling. **2.25**

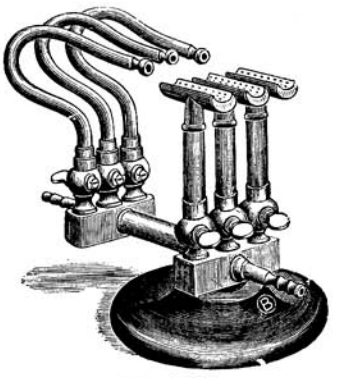
3687 BLAST LAMP, GASOLINE, one pint capacity, giving an intensely hot blue flame which can be regulated to a small pointed flame or brush flame as desired. Of seamless drawn brass and fitted with an automatic brass pump. **8.25**



Nos. 3699 to 3701



Nos. 3695 to 3697



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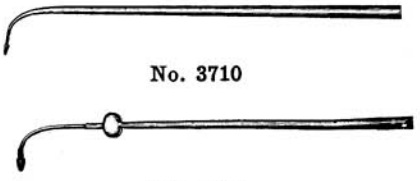

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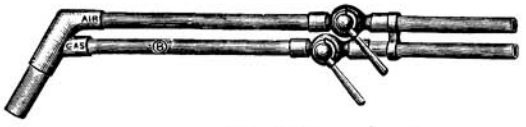

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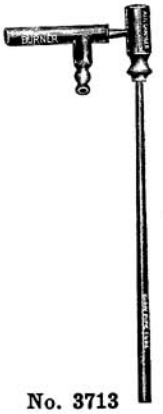
No. 3722



No. 3713

3695 **BLOWER, FOOT, air reservoir above,** diameter of reservoir 7¼ inches, pressure of blast per inch 1 lb., cubic feet of air per hour 190. With single disc..... **$9.50**

3696 ——, diameter of reservoir 9 inches, pressure of blast per inch 1¼ lbs., cubic feet of air per hour 330. With double disc..... **12.50**

3697 ——, diameter of reservoir 11 inches, pressure of blast per inch 1¾ lbs., cubic feet of air per hour 625. With three discs..... **17.25**

3699 **BLOWER, FOOT, with legs, air reservoir below.** Diameter of reservoir 7¼ inches, pressure of blast per inch 1 lb., cubic feet of air per hour 190. With single disc..... **10.75**

3700 ——, diameter of reservoir 9 inches, pressure of blast per inch 1¼ lbs., cubic feet of air per hour 330. With double disc..... **14.25**

3701 ——, diameter of reservoir 11 inches, pressure of blast per inch 1¾ lbs., cubic feet of air per hour 625. With three discs..... **19.50**

3702 **RUBBER DISC,** made of the best quality para rubber, steam cured. 9⅛ inches diameter, for use with Blowers **Nos. 3695** and **3699**.....Each **.60**

3702A ——, same as above, but 11¼ inches diameter, for use on Blowers **Nos. 3696** and **3700**.....Each **.90**

3702B ——, same as above, but 14¼ inches diameter, for use on Blowers **Nos. 3697** and **3701**.....Each **1.25**

3702C **BLOWER NETS,** as used on above blowers, small.....Each **.50**

3702D ——, medium.....Each **.60**

3702E ——, large.....Each **.75**

3710 **BLOWPIPES,** of brass, plain.

	a	b
Length, inches	8	10
Each	**$0.20**	**.25**

3711 **BLOWPIPES,** of brass, with bulb.

	a	b
Length, inches	8	10
Each	**$0.50**	**.55**

3713 **INSTITUTE COMBINATION BLOWPIPE AND HAND BURNER.** Special blowpipe burner is attached directly to the blowpipe. Gas tubing to be connected to burner. Recommended that one end of a piece of rubber tubing be connected to blowpipe and the other end placed in the mouth. By adjusting the flow of gas, one can obtain a perfect blowpipe flame from needle-point size to a hot brush flame. The most convenient, efficient blowpipe made..... **2.25**

3720 **BLOWPIPE, AUTOMATIC BRAZING,** nickel-plated, for light soldering. Length 10 inches..... **4.75**

3722 **BLOWPIPE, AUTOMATIC BRAZING, with pilot light.** Small size, of brass, with two stopcocks, $\frac{3}{16}$-inch air tube and $\frac{3}{8}$-inch gas tube. Length 11 inches..... **3.50**

3724 **BLOWPIPE, AUTOMATIC BRAZING,** for general work. Of brass, with two stopcocks, $\frac{5}{16}$-inch air tube and $\frac{5}{8}$-inch gas tube. Length 16 inches..... **5.75**

3726 **BLOWPIPES, GLASS BLOWERS' FIRES OR BURNERS.** Two required, one mounted opposite to other. For use with foot blowers or other forms of blast. Each with three burners. Mounted as illustrated on stand. Per set of two each as illustrated..... **19.00**

BONE SAW. See **No. 5214.**

BOTANICAL MOUNTS. See **Specimen Mounts.**

BOTANICAL PRESS. See **Plant Press.**

No. 3736 No. 3735

3735	**BOTTLES, prescription,** narrow mouth.	**a**	**b**	**c**	**d**	**e**	**f**
	Capacity, ounces	1	2	4	8	16	32
	Each	**$0.05**	**.06**	**.08**	**.11**	**.16**	**.24**
3736	**BOTTLES, prescription,** wide mouth.	**a**	**b**	**c**	**d**	**e**	**f**
	Capacity, ounces	1	2	4	8	16	32
	Each	**$0.05**	**.07**	**.09**	**.12**	**.16**	**.24**

No. 3737 No. 3738

3737	**BOTTLES, tincture,** narrow mouth, with ground glass stopper.	**a**	**b**	**c**	**d**	**e**	**f**
	Capacity, ounces	1	2	4	8	16	32
	Each	**$0.12**	**.14**	**.18**	**.25**	**.35**	**.50**
3738	**BOTTLES, salt mouth,** wide mouth with ground glass stopper.	**a**	**b**	**c**	**d**	**e**	**f**
	Capacity, ounces	1	2	4	8	16	32
	Each	**$0.12**	**.15**	**.20**	**.30**	**.40**	**.60**

3740	**BOTTLES, ACID or STORAGE,** with ground-glass stoppers.	**a**	**b**
	Capacity, pints	1	5
	Each	**$0.30**	**.60**

No. 3742 No. 3743 No. 3747 No. 3749 No. 3753

3742	**BOTTLE, ASPIRATOR,** with tubulature for rubber tubing, capacity 32 ounces	**$2.65**
3742A	——, capacity one gallon	**4.55**
3743	**BOTTLE, ASPIRATOR,** fitted with glass stopper and glass faucet. Capacity one gallon	**7.50**
3743A	——, without stopper and glass faucet	**4.55**
3747	**BOTTLE, BALSAM or DROPPING,** with ground glass cap and glass rod. Capacity 2 ounces	**.50**
3749	**BOTTLE, DROPPING,** bulb pipette, ground into the neck, forms an air-tight container. Capacity one ounce	**.38**
3753	**BOTTLES, DROPPING,** with grooves in neck and in stopper. When the grooves coincide, the contents may be poured out drop by drop. A quarter turn of the stopper closes the bottle air tight.	
	a	**b**
	Capacity, ounces 1	2
	Each **$0.35**	**.45**
3754	**BOTTLES, OIL SAMPLING,** 4-ounce size, fitted with cork stoppers ..... Per dozen	**2.40**

BOTTLES FOR REAGENTS

RAISED LABELS

Surfaces of Letters Ground

These bottles will show no free alkali. They are unusually hard and more brilliant than ordinary bottle glass. The shapes are uniform and various sizes are uniform in height.

The raised ground letters are clearly legible, regardless of the color of reagent or solution contained in the bottle.

Blank Bottles

Teachers can print any label desired on the **Blank Bottles.** Use **No. 6292 Indelible Pencil** if permanent labels **are not** desired; **No. 6291 Diamond Pencil** if permanent labels **are** desired.

ORDER BY CATALOGUE AND BOTTLE NUMBER

3755 BOTTLES, REAGENT, narrow mouth, 1 oz., height 3⅝ inches.....Per dozen **$2.00**

No.	*Name*	*Symbol*
326	Cobaltous Nitrate	$Co(NO_3)_2$
336	Gold Chloride	$AuCl_3$
327	Platinic Chloride	$PtCl_4$
325	Silver Nitrate (Amber)	$AgNO_3$
341	Blank	

3755A BOTTLES, REAGENT, wide mouth, 1 oz., height, 3⅛ inches.....Per dozen **$2.10**

No.	*Name*	*Symbol*
374	Ammonium Phosphate	$(NH_4)_2HPO_4$
361	Ammonium Sodium Phosphate	$NaNH_4HPO_4$
351	Borax	$Na_2B_4O_7$
364	Copper	Cu
365	Ferrous Sulphate	$FeSO_4$
366	Ferrous Sulphide	FeS
377	Phenyl Hydrazine	C_6H_5NH,NH_2
367	Potassium Chlorate	$KClO_3$
358	Potassium Cyanide	KCN
368	Potassium Ferricyanide	$K_3Fe(CN)_6$
354	Potassium Nitrate	KNO_3
353	Sodium Acetate	$NaC_2H_3O_2$
369	Sodium Bitartrate	$NaHC_4H_4O$
350	Sodium Carbonate	Na_2CO_3
370	Sodium Nitrate	$NaNO_3$
376	Sod. Pot. Carbonate	Na_2CO_3,K_2CO_3
371	Starch	
372	Test Paper	
373	Zinc	
375	Blank	

3756 BOTTLES, REAGENT, narrow mouth, 4 oz., height, 5¼ inches.....Per dozen **$3.00**

No.	*Name*	*Symbol*
3	Acetic Acid	$HC_2H_3O_2$
30	Alcohol	C_2H_5OH
439	Ammonium Acetate	$NH_4C_2H_3O_2$
18	Ammonium Carbonate	$(NH_4)_2CO_3$
17	Ammonium Chloride	NH_4Cl
15	Ammonium Hydroxide	NH_4OH
440	Ammonium Hydroxide, Con.	NH_4OH
441	Ammonium Hydroxide, Dil.	NH_4OH
82	Ammonium Molybdate	$(NH_4)_6Mo_7O_{24}$
19	Ammonium Oxalate	$(NH_4)_2C_2O_4$
16	Ammonium Sulphide (Amber)	$(NH_4)_2S$
31	Ammonium Sulphocyanide	NH_4CNS
97	Ammonium Sulphydrate	NH_4HS
33	Barium Carbonate	$BaCO_3$
20	Barium Chloride	$BaCl_2$
32	Barium Hydroxide	$Ba(OH)_2$
401	Barium Nitrate	$Ba(NO_3)_2$
406	Bromine Water	
21	Calcium Chloride	$CaCl_2$
23	Calcium Hydroxide	$Ca(OH)_2$
22	Calcium Sulphate	$CaSO_4$
83	Carbon Disulphide	CS_2
407	Chloroform	$CHCl_3$
408	Cochineal	
36	Cupric Sulphate	$CuSO_4$
421	Dimethyl Glyoxime	$(CH_3)_2C_2(NOH)_2$
646	Esbach's Reagent	
35	Ether	$(C_2H_5)_2O$
58	Fehling's Solution	
29	Ferric Chloride	Fe_2Cl_6
28	Ferrous Sulphate	$FeSo_4$
2	Hydrochloric Acid	HCl
419	Hydrochloric Acid, Con.	HCl
429	Hydrochloric Acid, Dil.	HCl
428	Hydrogen Peroxide	H_2O_2
1	Hydrogen Sulphide (Amber)	H_2S
87	Indigo Solution	
414	Iodine Solution	$I+KI$
27	Lead Acetate	$Pb(C_2H_3O_2)_2$
410	Litmus	
90	Magnesia Mixture	
438	Magnesium Chloride	$MGCl_2$
24	Magnesium Sulphate	$MgSO_4$
25	Mercuric Chloride	$HgCl_2$
86	Mercurous Nitrate	$Hg_2(NO_3)_2$
415	Methyl Alcohol	CH_3OH
411	Methyl Orange	
435	Millon's Reagent	
88	Nessler's Solution	
5	Nitric Acid	HNO_3
422	Nitric Acid, Con	HNO_3
430	Nitric Acid, Dil	HNO_3
93	Oxalic Acid	$H_2C_2O_4$
423	Phenol	C_6H_5OH
412	Phenolphthalein	
37	Platinic Chloride	$PtCl_4$
8	Potassium Carbonate	K_2CO_3
96	Potassium Chromate	K_2CrO_4
432	Potassium Cyanide	KCN
13	Potassium Dichromate	$K_2Cr_2O_7$
11	Potassium Ferricyanide	$K_3Fe(CN)_6$
6	Potassium Ferrocyanide	$K_4Fe(CN)_6$
12	Potassium Hydroxide	KOH
10	Potassium Iodide	KI

3756 BOTTLES, REAGENT, narrow mouth, 4 oz., height 5¼ inches *(Continued)* .....Per dozen **$3.00**

No.	*Name*	*Symbol*
9	Potassium Sulphate	K_2SO_4
7	Potassium Sulphocyanide	KCNS
26	Silver Nitrate (Amber)	$AgNo_3$
404	Silver Sulphate	Ag_2SO_4
60	Sodium Acetate	$NaC_2H_3O_2$
59	Sodium Carbonate	Na_2CO_3
416	Sodium Cobaltic Nitrite	
61	Sodium Hydroxide	NaOH
14	Sodium Phosphate	Na_2HPO_4
417	Sodium Thiosulphate	$Na_2S_2O_3$
81	Stannous Chloride	$SnCl_2$
4	Sulphuric Acid	H_2SO_4
420	Sulphuric Acid, Con	H_2SO_4
431	Sulphuric Acid, Dil	H_2SO_4
413	Tumeric	
56	Uranium Acetate	$UO_2(C_2H_3O)_2$
38	Blank	

3756A BOTTLES, REAGENT, wide mouth, 4 oz., height, 4⅞ inches.....Per dozen **$3.25**

No.	*Name*	*Symbol*
314	Ammonium Sulphate	$(NH_4)_2SO_4$
304	Borax	$Na_2B_4O_7$
305	Ferrous Sulphate	$FeSO_4$
303	Potassium Cyanide	KCN
302	Potassium Nitrate	KNO_3
313	Sod. Am. Hyd. Phos	$Na(NH_4)HPO_4+4H_2O$
301	Sodium Carbonate	Na_2CO_3
312	Test Paper	
307	Blank	

3758 BOTTLES, REAGENT, narrow mouth, 8 oz., height, 6½ inches.....Per dozen **$4.00**

No.	*Name*	*Symbol*
131	Acetic Acid	$HC_2H_3O_2$
126	Alcohol	C_2H_5OH
110	Ammonium Carbonate	$(NH_4)_2CO_3$
109	Ammonium Chloride	NH_4Cl
108	Ammonium Hydroxide	NH_4OH
155	Ammonium Molybdate	$(NH_4)_6Mo_7O_{24}$
130	Ammonium Oxalate	$(NH_4)_2C_2O_4$
158	Ammonium Phosphate	$(NH_4)_2HPO_4$
122	Ammonium Sulphide (Amber)	$(NH_4)_2S$
163	Barium Acetate	$(C_2H_3O_2)_2$
114	Barium Chloride	$BaCl_2$
151	Calcium Hydroxide	$Ca(OH)_2$
159	Ether	$(C_2H_5)_2O$
154	Ferrous Sulphate	$FeSO_4$
162	Hydrochloric Acid	HCl
105	Hydrochloric Acid, Con	HCl
106	Hydrochloric Acid, Dil	HCl
107	Hydrogen Sulphide (Amber)	H_2S
152	Lead Acetate	$Pb(C_2H_3O_2)_2$
153	Mercuric Chloride	$HgCl_2$
103	Nitric Acid, Con	HNO_3
104	Nitric Acid, Dil	HNO_3
171	Potassium Carbonate	K_2CO_3
160	Potassium Chromate	K_2CrO_4
172	Potassium Ferricyanide	$K_3Fe(CN)_6$
173	Potassium Ferrocyanide	$K_4Fe(CN)_6$
150	Potassium Hydroxide	KOH
145	Silver Nitrate (Amber)	$AgNO_3$
112	Sodium Carbonate	Na_2CO_3
111	Sodium Hydroxide	NaOH
129	Sodium Phosphate	Na_2HPO_4
156	Stannous Chloride	$SnCl_2$
101	Sulphuric Acid, Con	H_2SO_4
102	Sulphuric Acid, Dil	H_2SO_4
116	Blank	

3759 BOTTLES, REAGENT, narrow mouth, 16 oz. (pint), height, 7¾ inches.....Per dozen **$4.75**

No.	*Name*	*Symbol*
237	Acetic Acid	$HC_2H_3O_2$
239	Alcohol	C_2H_5OH
241	Ammonium Acetate	CH_3COONH_4
235	Ammonium Carbonate	$(NH_4)_2CO_3$
234	Ammonium Chloride	NH_4Cl
204	Ammonium Hydroxide	NH_4OH
227	Ammonium Hydroxide, Dil	NH_4OH+Aq
258	Ammonium Oxalate	$(NH_4)_2C_2O_4$
229	Ammonium Sulphide, Dil	$(NH_4)_2S+Aq$
236	Ammonium Sulphide (Amber)	$(NH_4)_2S$
218	Barium Chloride	$BaCl_2$
223	Calcium Hydroxide	$Ca(OH)_2$
225	Calcium Sulphate	$CaSo_4$
230	Ether	$(C_2H_5)_2O$
224	Ferrous Sulphate	$FeSo_4$
217	Hydrochloric Acid	HCl
222	Hydrochloric Acid, Con	HCl
231	Hydrochloric Acid, Dil	HCl
226	Hydrodisodic Phosphate	Na_2HPO_4
216	Nitric Acid	HNO_3
219	Nitric Acid, Con	HNO_3
232	Nitric Acid, Dil	HNO_3
238	Potassium Chromate	K_2CrO_4
259	Potassium Dichromate	$K_2Cr_2O_7$
221	Potassium Hydroxide	KOH
240	Silver Nitrate	$AgNO_3$
260	Sodium Carbonate	Na_2CO_3
233	Sodium Hydroxide	NaOH
228	Sodium Hydroxide, Dil	NaOHAq
215	Sulphuric Acid	H_2SO_4
220	Sulphuric Acid, Con	H_2SO_4
242	Sulphuric Acid, Dil	H_2SO_4
211	Blank	

3761 BOTTLES, REAGENT, narrow mouth, 32 oz. (quart), height, 9½ inches.....Per dozen **$7.50**

No.	*Name*	*Symbol*
512	Ammonium Hydroxide	NH_4OH
505	Hydrochloric Acid, Con	HCl
506	Hydrochloric Acid, Dil	HCl
503	Nitric Acid, Con	HNO_3
504	Nitric Acid, Dil	HNO_3
501	Sulphuric Acid, Con	H_2SO_4
502	Sulphuric Acid, Dil	H_2SO_4
511	Blank	

3762 BOTTLES, REAGENT, narrow mouth, 4 oz., Laboratory Desk Equipment.

No.	Name	Symbol
15	Ammonium Hydroxide	NH_4OH
2	Hydrochloric Acid	HCl
5	Nitric Acid	HNO_3
61	Sodium Hydroxide	$NaOH$
4	Sulphuric Acid	H_2SO_4

Set of five bottles **$1.25**

3762A BOTTLES, REAGENT, narrow mouth, 8 oz., Laboratory Desk Equipment.

No.	Name	Symbol
108	Ammonium Hydroxide	NH_4OH
106	Hydrochloric Acid, Dil	HCl
104	Nitric Acid, Dil	HNO_3
111	Sodium Hydroxide	$NaOH$
102	Sulphuric Acid, Dil	H_2SO_4
312	Test Paper (4 oz.) wide mouth	

Set of six bottles **$2.00**

3762B BOTTLES, REAGENT, narrow mouth, 16 oz., Laboratory Desk Equipment.

No.	Name	Symbol
204	Ammonium Hydroxide	NH_4OH
231	Hydrochloric Acid, Dil	HCl
232	Nitric Acid, Dil	HNO_3
233	Sodium Hydroxide	$NaOH$
242	Sulphuric Acid, Dil	H_2SO_4
312	Test Paper (4 oz.) wide mouth	

Set of six bottles **$2.38**

3765 BOTTLES, REAGENT, narrow mouth, 4 oz., Lecture Desk Equipment.

No.	Name	Symbol
3	Acetic Acid	$HC_2H_3O_2$
15	Ammonium Hydroxide	NH_4OH
16	Ammonium Sulphide	$(NH_4)_2S$
20	Barium Chloride	$BaCl_2$
23	Calcium Hydroxide	$Ca(OH)_2$
2	Hydrochloric Acid	HCl
1	Hydrogen Sulphide (Amber)	H_2S
27	Lead Acetate	$Pb(C_2H_3O_2)_2$
5	Nitric Acid	HNO_3
26	Silver Nitrate	$AgNO_3$
61	Sodium Hydroxide	$NaOH$
4	Sulphuric Acid	H_2SO_4

Set of twelve bottles **$3.00**

3765A BOTTLES, REAGENT, narrow mouth, 4 oz., selection according to Fresenius.

No.	Name	Symbol
3	Acetic Acid	$HC_2H_3O_2$
18	Ammonium Carbonate	$(NH_4)_2CO_3$
17	Ammonium Chloride	NH_4Cl
15	Ammonium Hydroxide	NH_4OH
19	Ammonium Oxalate	$(NH_4)_2C_2O_4$
16	Ammonium Sulphide (Amber)	$(NH_4)_2S$
20	Barium Chloride	$BaCl_2$
32	Barium Hydroxide	$Ba(OH)_2$
23	Calcium Hydroxide	$Ca(OH)_2$
22	Calcium Sulphate	$CaSO_4$
36	Cupric Sulphate	$CuSO_4$
29	Ferric Chloride	Fe_2Cl_6
2	Hydrochloric Acid	HCl
27	Lead Acetate	$Pb(C_2H_3O_2)_2$
25	Mercuric Chloride	$HgCl_2$
5	Nitric Acid	HNO_3
13	Potassium Dichromate	K_2Cr_2O7
6	Potassium Ferrocyanide	$K_4Fe(CN)_6$
7	Potassium Sulphocyanide	$KCNS$
26	Silver Nitrate (Amber)	$AgNO_3$
59	Sodium Carbonate	Na_2CO_3
61	Sodium Hydroxide	$NaOH$
14	Sodium Phosphate	Na_2HPO_4
4	Sulphuric Acid	H_2SO_4

Set of twenty-four bottles **$6.00**

3765B BOTTLES, REAGENT, narrow mouth, 4 oz., most commonly used chemical labels.

No.	Name	Symbol
3	Acetic Acid	$HC_2H_3O_2$
30	Alcohol	C_2H_5OH
18	Ammonium Carbonate	$(NH_4)_2CO_3$
17	Ammonium Chloride	NH_4Cl
15	Ammonium Hydroxide	NH_4OH
19	Ammonium Oxalate	$(NH_4)_2C_2O_4$
16	Ammonium Sulphide (Amber)	$(NH_4)_2S$
31	Ammonium Sulphocyanide	NH_4CNS
33	Barium Carbonate	$BaCO_3$
20	Barium Chloride	$BaCl_2$
32	Barium Hydroxide	$Ba(OH)_2$
21	Calcium Chloride	$CaCl_2$
23	Calcium Hydroxide	$Ca(OH)_2$
22	Calcium Sulphate	$CaSO_4$
36	Cupric Sulphate	$CuSO_4$
35	Ether	$(C_2H_5)_2O$
29	Ferric Chloride	Fe_2Cl_6
28	Ferrous Sulphate	$FeSO_4$
2	Hydrochloric Acid	HCl
1	Hydrogen Sulphide (Amber)	H_2S
27	Lead Acetate	$Pb(C_2H_3O_2)_2$
24	Magnesium Sulphate	$MgSO_4$
25	Mercuric Chloride	$HgCl_2$
5	Nitric Acid	HNO_3
8	Potassium Carbonate	K_2CO_3
13	Potassium Dichromate	$K_2Cr_2O_7$
11	Potassium Ferricyanide	$K_3Fe(CN)_6$
6	Potassium Ferrocyanide	$K_4Fe(CN)_6$
12	Potassium Hydroxide	KOH
10	Potassium Iodide	KI
9	Potassium Sulphate	K_2SO_4
7	Potassium Sulphocyanide	$KCNS$
26	Silver Nitrate (Amber)	$AgNO_3$
59	Sodium Carbonate	Na_2CO_3
61	Sodium Hydroxide	$NaOH$
14	Sodium Phosphate	Na_2HPO_4
4	Sulphuric Acid	H_2SO_4
38	Blank (three bottles)	

Set of forty bottles **$10.00**

No. 31–125 **No. 31–130C** **No. 3775** **No. 3777** **No. 3782** **No. 3784** **No. 3770**

31–125 **BOTTLE, SPECIFIC GRAVITY (PYKNOMETER),** with **GROUND-IN CENTIGRADE THERMOMETER.** With stoppered capillary tube. Capacity 50 cc. **$4.50**

31–130 **BOTTLES, SPECIFIC GRAVITY (PYKNOMETERS), accurately adjusted,** with perforated stoppers ground into necks.

	a	**b**	**c**	**d**
Capacity, cc.	10	25	50	100
Each	**$2.20**	**2.40**	**2.70**	**3.00**

31–132 **——, not adjusted,** with perforated stopper ground into neck. Capacity 25 cc. **1.45**

3770 **BOTTLES, SPECIMEN,** bent neck, square — will lie flat.

	a Small	**b** Medium	**c** Large
Size, ounces	½	1	2
Per dozen	**$1.15**	**1.50**	**2.20**

3775 **BOTTLES, WASHING, DRECHSEL'S,** with tubes ground into the neck.

	a	**b**	**c**
Capacity, cc.	125	250	500
Each	**$1.35**	**1.75**	**2.00**

3777 **BOTTLES, WASHING,** with antimony rubber stoppers and two bent tubes as illustrated.

	a	**b**	**c**
Capacity, cc.	250	500	1000
Each	**$0.40**	**.70**	**1.00**

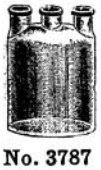
3782 **BOTTLES, WEIGHING,** cylindrical, light blown glass, with shoulder and ground-in glass stopper.

	a	**b**
Diameter and length, mm.	25×50	40×50
Each	**$0.65**	**1.00**

3784 **BOTTLES, WEIGHING, flat bottom,** ground glass stopper.

	a	**b**
Diameter, mm.	30	40
Length, mm.	50	50
Each	**$0.65**	**.85**

No. 3786



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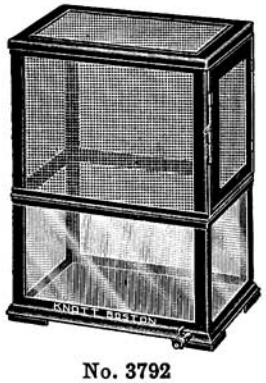

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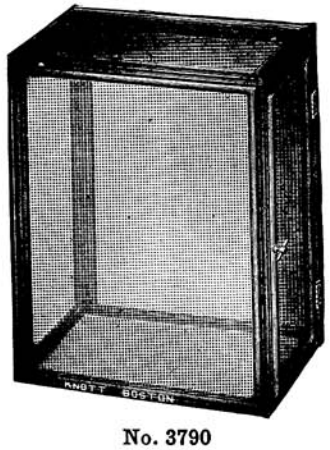


No. 3790

3786 **BOTTLES, WOULFF'S,** with two necks

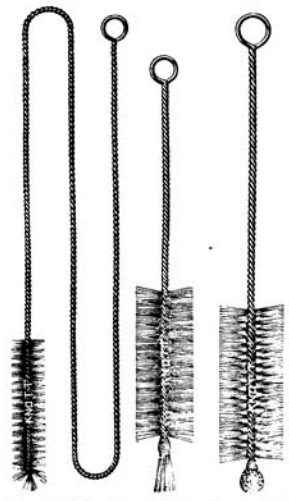
	a	**b**	**c**	**d**
Capacity, cc.	250	500	1000	2000
Each	**$2.75**	**3.00**	**4.00**	**5.00**

3787 **——, with three necks.**

	a	**b**	**c**	**d**
Capacity, cc.	250	500	1000	2000
Each	**$3.00**	**3.50**	**4.50**	**5.50**

3790 **BREEDING CAGE, HARCOURT, FOR INSECTS.** Wooden frame, solid bottom, gauze front, back, top and sides. One end hinged and provided with clasp. Outside 24×18×12 inches. **9.50**

3792 **BREEDING CAGE, KNOTT'S, FOR AQUATIC INSECTS.** Can also be used for wood boring larvæ, etc. This outfit is in reality a combination aquarium and breeding cage. The lower part is a substantially constructed aquarium 13½×8½×8 inches deep, inside dimensions. With glass front, back and ends, and provided with stopcock. The upper part measures 14×11×9 inches over all and is provided with glass front and gauze back and ends. One end is hinged and provided with clasp. Substantially framed in metal and painted throughout. Top removable. Dimensions over all 14¾ inches long, 10 inches wide, 20¼ inches high **25.00**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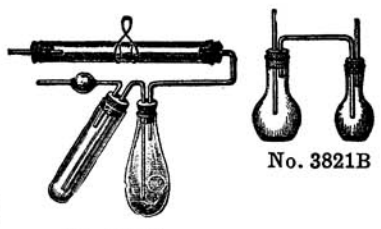
No. 3802 No. 3803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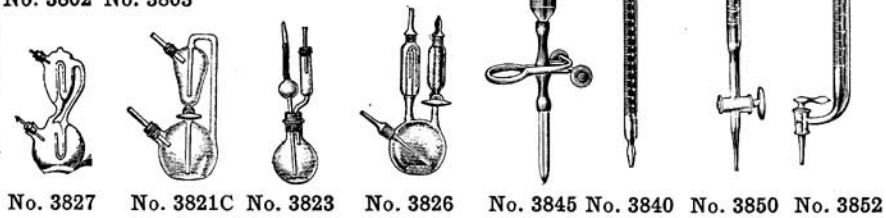
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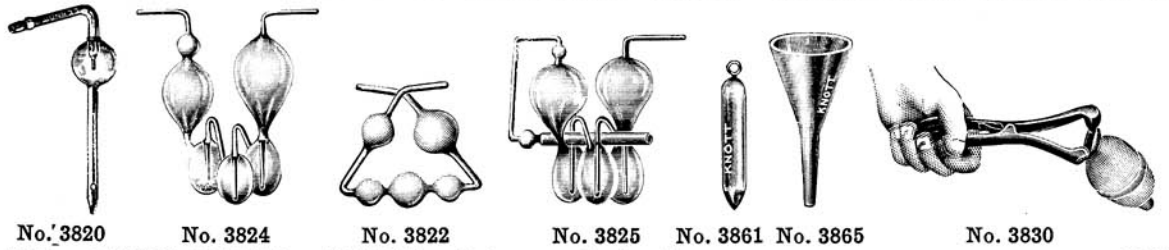

No. 3820 No. 3824 No. 3822 No. 3825 No. 3861 No. 3865 No. 3830

3802	**BRUSH, BEAKER or FUNNEL,** with long wooden handle	$0.20
3803	**BRUSH, BOTTLE,** with wood handle	.55
3805	**BRUSH, BURETTE, or TUBE,** with 3-foot wire handle	.18
16–250	**BRUSH, CAMEL'S-HAIR,** ½-inch wide, best quality	.22
3808	**BRUSH, "COUNTER,"** best quality. Should be in every laboratory	1.15
3810	**BRUSH, TEST TUBE, bristle end,** wire handle	.10
3811	**BRUSH, TEST TUBE, sponge end,** wire handle	.12
3813	**BRUSH, TUBE, for narrow tubes,** wire handle	.05
3820	**BULB, CONNECTING, Hopkins' New Form**	.75
3821A	**BULB, POTASH** (Alkalimeter) after Berzelius	1.75
3821B	——, after Fresenius and Wills	1.50
3821C	——, after Kipp	3.50
3822	——, after Liebig, with five bulbs	.75
3823	——, after Mohr	2.00
3824	——, after Mohr, improved by Geissler	1.75
3825	——, after Mohr, improved by Geissler, with **drying tube** attached	2.75
3826	——, after Rohrbeck	3.75
3827	——, after Rose	2.75
3830	**BULB AND TUBE EXPANDER,** for stretching necks of rubber bulbs	.75

3840 BURETTES, MOHR'S, for **pinchcock.** Without fittings. Subdivided into tenths.

	a	b	c	d
Capacity, cc.	10	25	50	100
Each	$0.70	.75	1.00	1.50

3845	**ATTACHMENT,** Glass Tips, Rubber Tubing and Pinchcock for use with **No. 3840,** above	.25

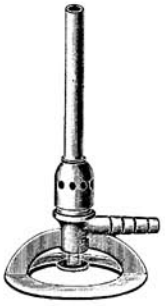
3850 BURETTES, GEISSLER'S, with straight glass stopcocks. Subdivided into tenths.

	a	b	c	d
Capacity, cc.	10	25	50	100
Each	$1.80	1.90	2.10	2.50

3852	**BURETTE, FRESENIUS',** 25cc. ×1/10 cc.	2.20
3853	——, 50 cc. ×1/10 cc.	2.50
3861	**BURETTE FLOAT,** Erdmann's. When ordering state the accurate inside diameter of the burette.	.50
3865	**BURETTE FUNNELS** ..... Each	.20

BUNSEN BURNERS

Our selection of **BUNSEN BURNERS** from the many designs on the market, has been based upon greatest laboratory utility. Thus, there will be found in this list only burners which have given entire satisfaction and which have shown, from experience, that they are well worthy a place in this edition of our catalogue. Each burner is carefully constructed and rigidly tested. The finish is durable, and designed to withstand rough usage and the corrosive action of chemicals in the chemical laboratories. We have given a considerable latitude for choice, and there will be found in this list burners to meet every need.



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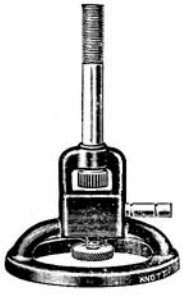

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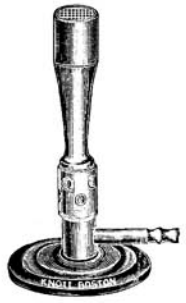
No. 60–20



No. 3872

60–10 **INSTITUTE BUNSEN BURNER** for gasoline or illuminating gas. Gives intense, hot flame; gas and air regulator. We have greatly improved the design of this burner, and employ extra heavy gauge metal. It has every refinement and is handsomely finished. Tube, 7/16-inch diameter..... **$1.70**

60–12 **HARVARD BUNSEN BURNER** for gasoline and illuminating gas. Gas and air regulation by knurled screws; gas mixes at all angles, insuring perfect mixture. Tube has threaded top for screwing on Burner Star for holding a Burner Chimney..... **1.80**

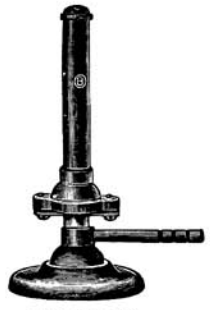
60–17 **PILOT LIGHT BUNSEN BURNER** for illuminating gas. Screw regulator for pilot, stopcock for shut-off, air regulator, tube 7/16-inch diameter..... **2.50**

60–20 **SCHOOL BUNSEN BURNER** for illuminating gas. Air regulator; tube, 7/16-inch diameter ..... **.45**

3872 **BURNER, MEKER TYPE**, for coal gas. These burners are very powerful, requiring a reasonably high gas pressure; temperature nearly uniform throughout. Top or grid, 24 mm. diameter; height, 155 mm. **3.00**

No. 60–27

No. 60–30



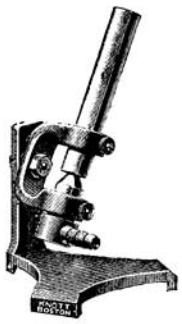
No. 60–35

60–27 **LOW FORM BUNSEN BURNER** for illuminating gas. Air regulator; tube, 7/16-inch diameter; height, 3 inches..... **.60**

60–30 **GILLEY LOW FORM BUNSEN BURNER** designed especially for use with Hypsometer **No. 60–350.** Gives hot flame and can be generally used..... **.65**

60–35 **ACETYLENE GAS BUNSEN BURNER.** Gives intense flame; tube, 9/16-inch diameter..... **2.90**

No. 60–40



No. 60–45

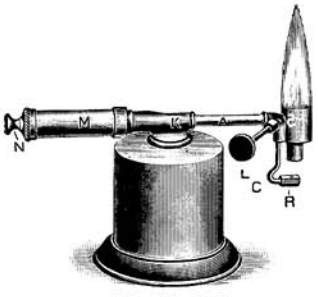
No. 60–120

60–40 **SEMI-BLAST WYNNE BURNER,** supplying either a very hot Bunsen flame or a semi-blast flame—in some respects preferable to the ordinary blast flame. The **original Wynne Burner** has been unsuccessfully copied by other manufacturers who have used lighter weight materials and cheaper construction, disregarding the form of the inner combustion chamber, the correct design for which, in our burner, has made it so prominent a success. The **original design** of which we are the originators is **by far the most efficient inexpensive heat source** ever put on the market. By proper adjustment of air and gas we can procure a flame from that of an ordinary Bunsen flame to an intense flame which for some purposes is superior and more easily obtained than from blast lamps. By reference to the illustration it will be noted that one may adjust the direction of the flame to any direction. To insure the greatest utility accept only that burner which follows **exactly** the design of which we are the originators. At the present time no reproductions have given equally good results..... **$3.50**

60–45 ——, similar to, but without the universal adjustment obtainable in our **No. 60–40** **3.00**

60–120 **HOT BLAST ALCOHOL STOVE.** More efficient than regular alcohol burner. Weight approximately 5 oz. Complete with tripod support as illustrated..... **.45**

60–121 ——, without tripod support..... **.30**



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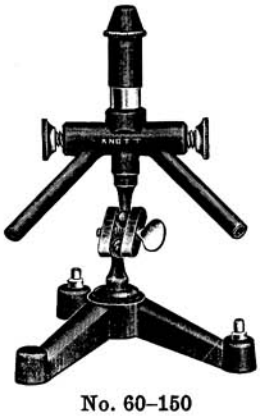

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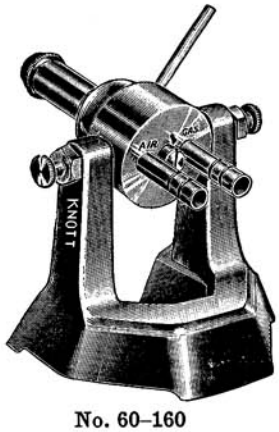


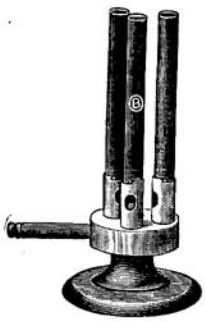
No. 60–160

60–135 **GASOLINE BURNER, ½-pint,** flame adjustable from very small height to 5 or 6 inches. Will burn 1¼ hours with one filling..... **9.60**

60–150 **UNIVERSALLY ADJUSTABLE BUNSEN BLAST LAMP,** stable and durable in construction, capable of the most exacting service. Will produce the maximum intensity of heat with the minimum consumption of gas. Both air and gas pipes supplied with stopcock..... **8.25**

60–152 **BUNSEN BLAST LAMP,** ordinary type with T-handle stopcocks..... **7.50**

60–160 **DOUBLE CONCENTRIC BUNSEN BLAST LAMP** for illuminating gas only.
This type of lamp has an inner air jet and an inner tube which may be used either for air or gas, and an external gas tube. The gas and air are changed automatically from the larger to the smaller tube by a slight movement of the lever at the back, the same movement also adjusting both gas and air to each other for each tube. This combination of practically two blowpipes gives a great range of power from a small-pointed jet to a brisk flame, using approximately 35 feet of gas per hour..... **14.50**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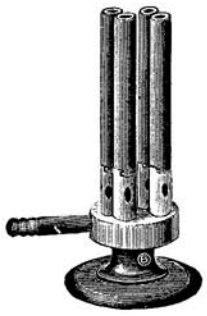
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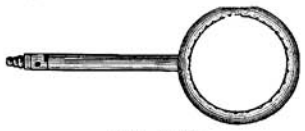
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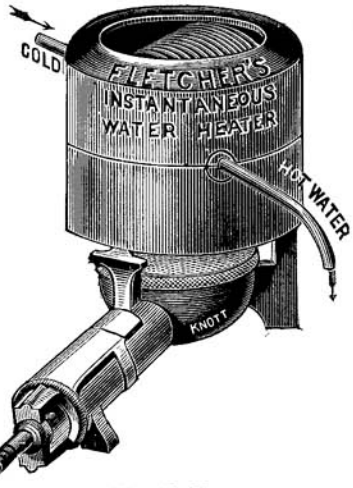
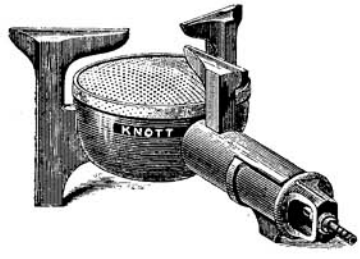


No. 60–80



No. 60–75

No. 3900

No. 3901

No. 3902

No. 3903

No. 3904

No. 3905

No. 3906

No. 3907

3881	**THREE-TUBE BURNER** with air regulators. Tubes, 7/16-inch diameter; height, 6 inches	**$3.30**
3882	**FOUR-TUBE BURNER** with air regulators. Tubes, 7/16-inch diameter; height, 6 inches	**3.80**
3890a	**RING BURNER** for heating funnels, etc. May be attached to any support. Diameter, 3 inches	**2.20**
3890b	——, 4 inches diameter	**2.40**
3890c	——, 6 inches diameter	**3.30**

BURNERS, GLASS BLOWERS'. See **BLOWPIPES.**

BURNERS FOR SOLDERING IRONS. See **SOLDERING IRON HEATERS.**

BURNER ATTACHMENTS

for

Burners with Tubes 7/16-Inch Diameter

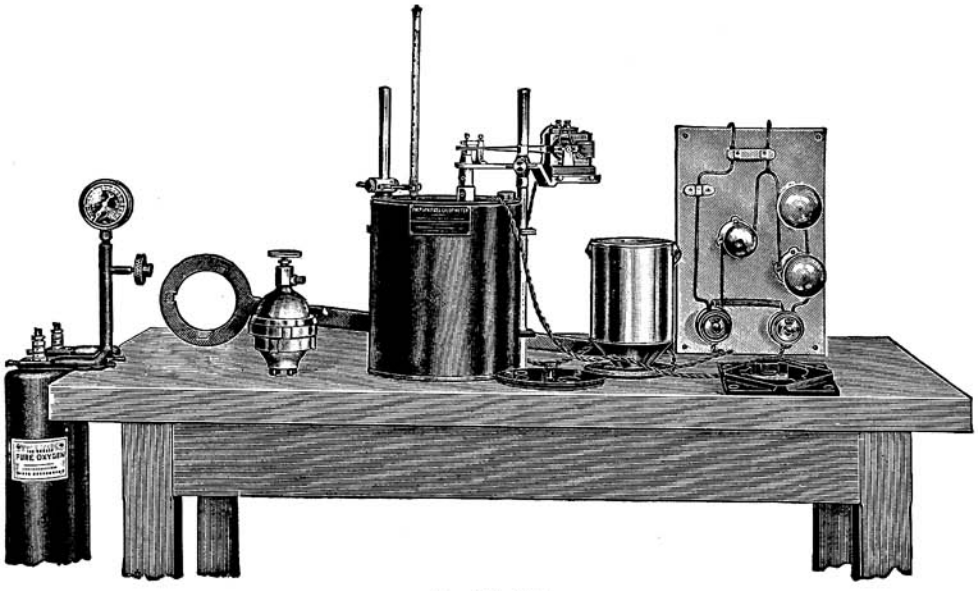
3900	**BURNER TUBE** for blowpiping with yellow flame. Fits inside the burner	**$0.20**
3901	**BURNER TIP** with rest for blowpipe	**.15**
3902	**BURNER CROWN** for heating small dishes. Gives a round flame	**.65**
3903	**BURNER GAUZE TOP** giving a large round flame	**.30**
3904	**BURNER WING TOP** for bending glass tubing, etc.	**.12**
3905	**BURNER STAR**	**.30**
3906	**BURNER TRIPOD**	**.20**
3907	**BURNER CHIMNEY** of sheet iron, 2 inches diameter at the bottom	**.20**
60–75	**SOLID BUNSEN FLAME STOVE.** The advantage of this burner is a broad flame of uniform temperature. It is especially desirable for heating water in quantities; also for rapid heating of **No. 60–365** Hypsometer	**4.00**
60–75A	**GAUZE TOPS** for above ..... Each	**.55**
60–80	**INSTANTANEOUS HOT WATER HEATER.** This apparatus consists of a coiled copper tube enclosed in a Russia iron case. Cold water enters at one end of tube; hot water is delivered at the other end — instantaneous in action. Complete as illustrated with Burner **No. 60–75**	**12.00**
60–81	**INSTANTANEOUS HOT WATER HEATER without Burner**	**8.00**

EMERSON FUEL CALORIMETERS

The Emerson Calorimeter is of the so-called " bomb " type, with its essential elements of operation the same as the original Berthelot type of instrument. It, however, embodies improvements in design over the older types of bomb calorimeters which tend to increase the durability of the instrument and greatly facilitate its operation.

The bomb calorimeter outfit for the determination of the heat values of fuels and combustibles consists primarily of a strong steel receptacle (called a bomb) into which the sample of combustible is placed, and within which it is completely burned. The sample is prepared in a finely divided condition, and to insure complete combustion it is placed in the bomb in the presence of pure oxygen under high pressure. At the desired time the fuel is ignited by means of a fuse wire dipping into the sample, which wire is brought to incandescence by means of the passage of an electric current.

During combustion the bomb is entirely immersed in a known amount of water, and the rise in temperature of the water is accurately measured with a standard thermometer. The product of this rise in temperature and the known weight of water (plus the water equivalent of the bomb and other immersed metal parts) gives us directly the heat units given off by the burning of the sample, whose weight has been previously determined. From this data the *British Thermal Units per pound* can be determined, which is the commercial value desired for industrial purposes.

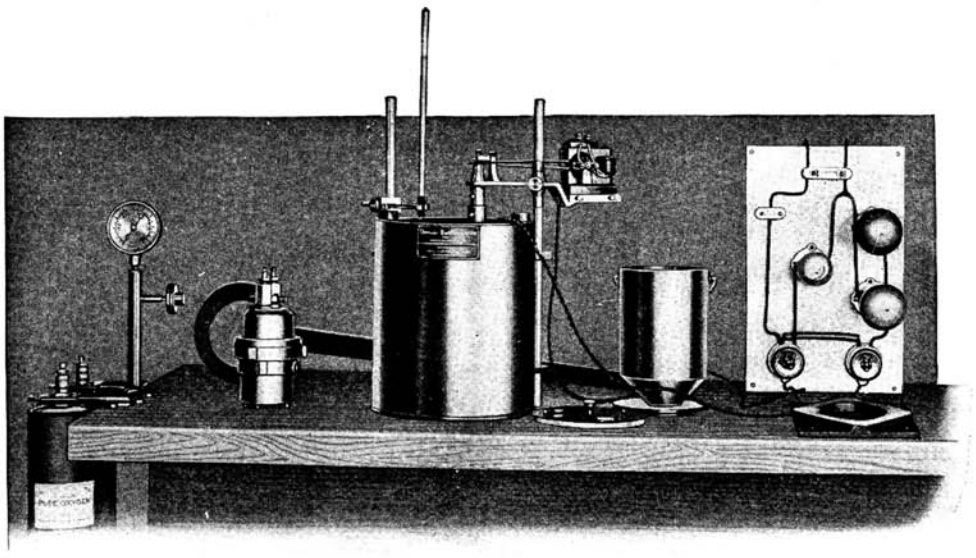


No. 66–140

The Emerson Fuel Calorimeter outfit, equipped with bomb having one valve at the top, is the standard type of calorimeter suitable for the determination of the heat of combustion of fuels and other combustibles. The instrument also offers the quickest possible method for determining the sulphur in combustible materials when the bomb to the outfit is equipped with acid-proof linings. This above instrument can be furnished with either nickel or gold-lined bomb. The internal capacity of the single valve bomb is 400 cc.

66–140 **CALORIMETER, EMERSON FUEL,** standard type of bomb calorimeter for determining the heat value of solid and liquid fuels. The outfit includes the following parts: single-valve steel bomb with spun-nickel linings and nickel interior fittings; calorimeter jacket with cover and posts; calorimeter bucket; double oxygen piping for two cylinders of oxygen, and with high pressure gauge (piping to regular outfit fits oxygen cylinders of S. S. White Dental Manufacturing Co.; single oxygen piping, with high pressure gauge to fit the Linde Air Products Co.'s cylinders, delivered with outfits where so specified); ball-bearing stirring device with belt-driven motor; special 3-foot spanner and cast-iron holder; thermometer holder; thermometer reader; ignition wire; gaskets; wire leads, etc. The water equivalent factor of the outfit is supplied without extra charge..... **$245.00**

66–140A ——, same as above, with gold-lined bomb..... **360.00**



No. 66–142

The Emerson Fuel Calorimeter Outfit, equipped with bomb **having two valves at the top,** is suitable for the determination of the heat of combustions of fuel, etc., and for the determination of the sulphur content of combustibles, and is used in the same manner for this work as the standard outfit with the single-valve bomb.

In addition to these above uses the double-valve bomb offers opportunity for analyzing the products of combustion which are formed in the bomb during ignition of the material under test. A particular application of this instrument used in this manner is the determination of the percentage of carbon in steel, by burning the same in the bomb in the presence of an excess of oxygen under pressure, in the same manner as a fuel, and subsequently analyzing the gases as they are exhausted from the bomb.

The above instrument can be furnished with either nickel or gold-lined bomb. The internal capacity of this double-valve bomb is 500 cc.

66–142 **CALORIMETER, EMERSON FUEL DOUBLE-VALVE BOMB,** standard type of bomb calorimeter **for determining the heat value of solid and liquid fuels,** and for determining the carbon in steel. The outfit includes double valve steel bomb, with spun-nickel linings, and nickel interior fittings; calorimeter jacket with cover and posts; calorimeter bucket; double-oxygen piping for two cylinders of oxygen, and with high pressure gauge (piping to regular outfit fits oxygen cylinders of S. S. White Dental Manufacturing Co. Single oxygen piping, with high pressure gauge, to fit the Linde Air Products Co.'s, cylinders, delivered with outfits where so specified); ball-bearing stirring device with belt-driven motor; special 3-foot spanner and cast-iron holder; thermometer holder; thermometer reader; ignition wire; gaskets; wire leads, etc. The water equivalent factor of the outfit is supplied without extra charge..... **$255.00**

66–142A ——, same as above, with **gold-lined bomb**..... **385.00**

ADIABATIC CALORIMETERS

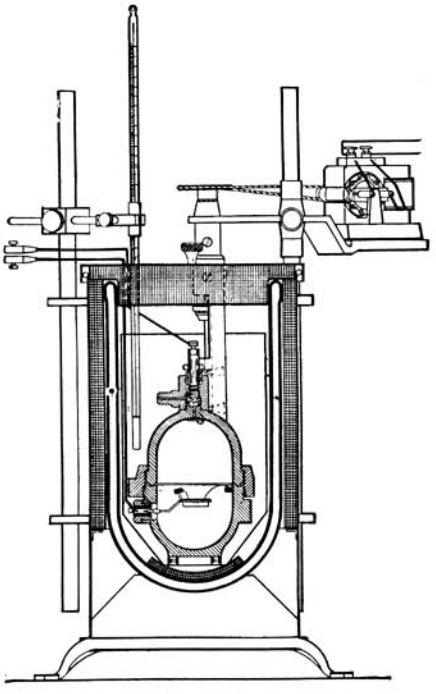
Vacuum-walled Jacket. A calorimetric test is always made under ideal conditions when the calorimeter bucket is surrounded with a jacket, or with suitable heat insulating material or conditions, so that there will be a minimum exchange of heat between the bucket and its surroundings. A vacuum wall furnishes, as is well known, an almost perfect heat insulating medium, and has therefore a very admirable application when used as a calorimeter jacket.

This is the simplest type of jacket to operate, which practically eliminates radiation and is quite satisfactory for general calorimetric work. If the temperature in the calorimeter with a vacuum-walled jacket, however, is not fairly close to that of the room temperature, an appreciable exchange of heat does take place.

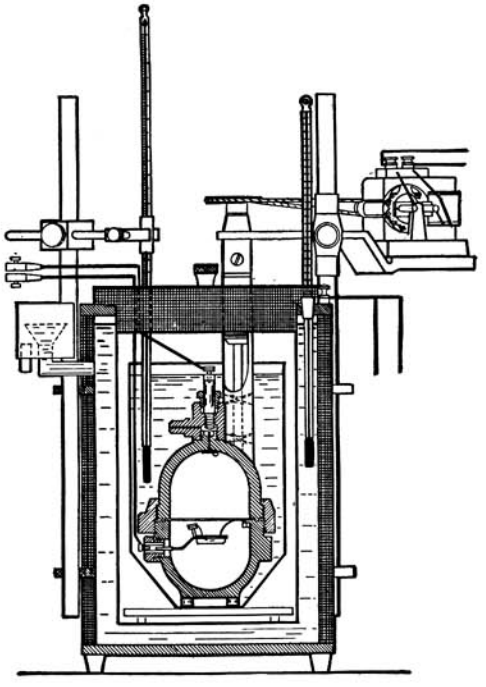
In addition to radiation when a test is made in a vacuum-walled jacket at a temperature considerably above the room temperature, the condensation of vapor on the cover and upper walls of the jacket may introduce considerable cooling effect. A vacuum-walled jacket when operated in proximity to room temperature gives satisfactory results and except for the fragile nature of the jacket is very desirable for commercial work.

DANIELS' ADIABATIC JACKET. Dr. Farrington Daniels of the Worcester Polytechnic Institute has perfected an adiabatic jacket in which he eliminates the radiations by carrying the temperature of the jacket along with the temperature of the calorimeter and obtains the rise of temperature in the jacket without the use of electric heating coils. In the Daniels' Jacket the jacket water itself is the heating unit, and by passing an electric current through the water its temperature is raised simultaneously with the calorimeter temperature. With the application of the current to the water jacket the temperature rises immediately and uniformly throughout the jacket.

In this manner the lag of the resistance wires of the heating coils is eliminated, as is also the stirring of the jacket water as the heat is not localized. It is a modification of Dr. Daniels' Jacket which has been applied to the Emerson Calorimeters, which are shown in the accompanying illustrations.



Equipped with Vacuum Walled Jacket



Equipped with Daniels' Adiabatic Jacket

66–143 **CALORIMETER, EMERSON FUEL, Vacuum Walled Jacket, Single Valve Bomb.** This outfit is complete as described under **No. 66–140,** but with **Vacuum Walled Jacket** in place of the regular calorimeter jacket. Bomb with spun nickel linings **$285.00**

66–143A ——, same as above, but with **gold lined bomb** **405.00**

N.B. VACUUM WALLED ADIABATIC JACKET CANNOT BE USED WITH CALORIMETER OUTFIT WITH DOUBLE VALVE BOMB (No. 66–142).

66–144 **CALORIMETER, EMERSON FUEL, Daniels' Adiabatic Jacket, Single Valve Bomb.** This outfit is complete as described under **No. 66–140,** but with **Daniels' Adiabatic Jacket** in place of the regular calorimeter jacket. Bomb with spun nickel linings **285.00**

66–144A ——, same as above, but with **gold lined bomb** **405.00**

66–145 **CALORIMETER, EMERSON FUEL, Daniels' Adiabatic Jacket, Double Valve Bomb.** The outfit is complete as described under **No. 66–142,** but with **Daniels' Adiabatic Jacket** in place of regular calorimeter jacket. Bomb with spun nickel linings **295.00**

66–145A ——, same as above, but with **gold lined bomb** **425.00**

N.B. THE DANIELS' JACKET IS DESIGNED TO OPERATE ONLY ON ALTERNATING CURRENT CIRCUIT OF 110 VOLTS.

For use on 220 volt circuit, use step-down transformer.

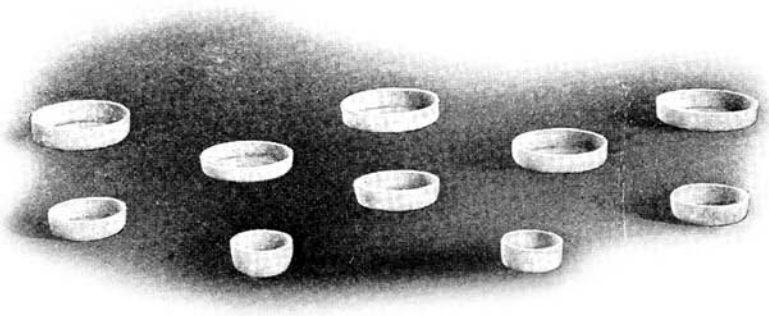
EMERSON CALORIMETER OUTFITS
AND
ADIABATIC JACKETS

Owners of the **regular calorimeter outfits** may have them equipped with adiabatic jackets. Outfits with double valve bomb **CANNOT BE FITTED WITH VACUUM-WALLED JACKET.**

66–147	**VACUUM-WALLED ADIABATIC JACKET** for single bomb calorimeter outfits. Cover and calorimeter bucket	**$75.00**
	ADDITIONAL COST FOR EQUIPPING the regular calorimeter outfit, single valve bomb type with **vacuum-walled adiabatic jacket**	**40.00**
66–148	**DANIELS' ADIABATIC JACKET** for **either** single valve or double valve bomb. Cover, calorimeter bucket, felt lagging, etc	**75.00**
	ADDITIONAL COST FOR EQUIPPING the regular calorimeter outfit with **Daniels' Adiabatic Jacket**	**40.00**

SEPARATE PARTS EMERSON FUEL CALORIMETER

66–150	**BOMB,** nickel lined, single valve, with nickel interior fittings	**$105.00**
66–150A	——, same as above, gold lined, with nickel interior fittings	**220.00**
66–151	**BOMB,** nickel lined, double valve, with nickel interior fittings	**120.00**
66–151A	——, same as above, gold lined, with nickel interior fittings	**250.00**
66–152A	**NICKEL LININGS** for single valve bomb (including upper and lower cup)	**12.00**
66–152B	——, for double valve bomb (including upper and lower cup)	**12.00**
66–152C	**GOLD LININGS** for single valve bomb (including upper and lower cup)	**120.00**
66–152D	——, for double valve bomb (including upper and lower cup)	**140.00**
66–153A	**LOWER CUP** of gold lining for double valve bomb	**85.00**
66–153B	**UPPER CUP** of gold lining for double valve bomb	**55.00**
66–153C	**FUEL PAN SUPPORT,** nickel	**2.40**
66–153D	**FUEL PAN,** nickel	**.60**
66–153E	**BINDING POST,** nickel (for the interior of bomb)	**1.35**
66–153F	**DEFLECTOR,** nickel	**.25**
66–153G	**DEFLECTOR SCREW,** nickel	**.35**
66–153H	**STIRRING DEVICE,** complete with motor	**34.00**
66–153I	**3-INCH LEAD WASHERS** Per dozen	**1.80**
66–153J	**CALORIMETER BUCKET**	**4.40**
66–153K	**INSULATION PLUG** (fitting into lower cup of bomb)	**4.40**
66–153L	**LEGS** for bomb (hard rubber, with screws) Each	**.20**
66–153M	**OXYGEN PIPING with Gauge**	**40.00**
66–153N	**THERMOMETER CLAMP AND HOLDER** complete	**7.25**
66–153O	**THERMOMETER TELESCOPE**	**4.00**
66–153P	**VACUUM WALLED FLASK** for adiabatic jacket	**12.00**
66–153Q	**VALVE TO BOMB,** without handle	**5.50**
66–153R	**SPECIAL 3-FOOT SPANNER**	**14.00**
66–153S	**CAST IRON PLATE HOLDER**	**7.00**
66–153T	**WIRE LEADS** with binding posts	**2.50**
66–153U	**IRON FUSE WIRE,** .004 inch diameter Per spool	**.60**



CAGES, BREEDING. See Breeding Cages.

CALCIUM CHLORIDE TUBES. See Tubes.

3915 **CALCIUM CHLORIDE HOLDER** for balance cases (see illustration below) **$0.50**

3925 **CAPSULES, CIRCULAR, FUSED SILICA.** (See index, "**Fused Silica Ware,**" for characteristics.)

Plain, glazed.	a	b	c	d	e	f	g	h
Approximate capacity, cc.	10	15	20	30	35	40	40	75
Diameter × depth, inches	1⅜×½	1¾×½	2×½	2¼×½	2⅜×½	2¾×⅝	2×1	3¼×1
Each	**$0.95**	**.95**	**1.28**	**1.28**	**1.50**	**1.84**	**1.84**	**1.84**

3926 **CAPSULE, CIRCULAR, FUSED SILICA,** 1¾ inches diameter × ¾ inch deep, 30 cc. capacity, same as above, but with handle, duplicating in shape the standard platinum dish for sugar analysis **$1.85**

No. 3915

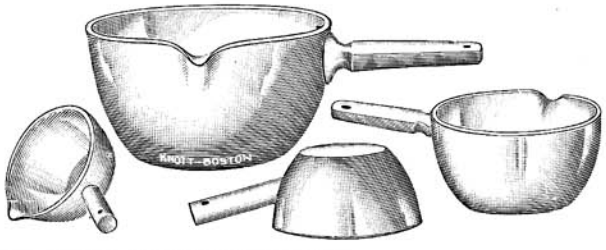
3927 **CAPSULES, IGNITION, ALUNDUM.** (See index, "**Alundum Ware,**" for characteristics.)

	a	b	c	d
Diameter, inches	1 1/32	1¼	1⅝	1¾
Height, inches	7/16	⅝	⅝	⅞
Capacity, cc.	7	10	18	25
Each	**$0.33**	**.45**	**.55**	**.55**

3929 **CAPSULES, RECTANGULAR, FUSED SILICA.** (See index, "**Fused Silica Ware,**" for characteristics.) Glazed.

	a	b	c
Approximate capacity, cc.	7	20	20
Length × width × depth, inches	2 3/16×15/16×⅜	1⅞×1½×⅝	2½×1⅜×⅜
Each	**$1.50**	**1.50**	**1.84**

3930 **CARBON DIOXIDE APPARATUS** for growing a plant without carbon dioxide (see National Biology Direction Sheets, Exp. F53) **$3.50**



3931 **CASSEROLES, AGATE WARE,** with attached handle.

	a	b	c	d
Capacity, cc.	250	500	750	1000
Each	**$0.45**	**.50**	**.55**	**.75**

3934 **CASSEROLES, PORCELAIN,** with porcelain handle.

	a	b	c	cc	d	e
Capacity, cc.	150	210	375	500	750	1250
Each	**$0.65**	**.94**	**1.20**	**1.54**	**1.86**	**2.68**

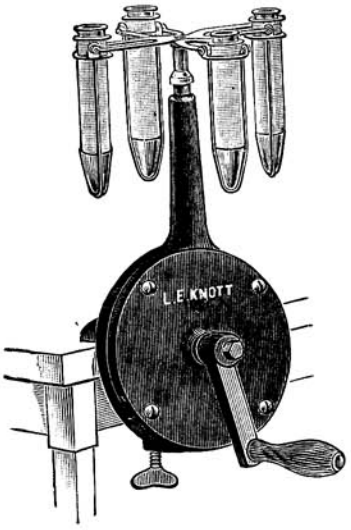
3938 **CASSEROLES, FUSED SILICA.** (See index, "**Fused Silica Ware,**" for characteristics.) Glazed.

	a	b	c	d	e
Approximate capacity, cc.	30	75	150	200	350
Diameter × depth, inches	2×1	2¾×1⅜	3¼×1¾	3¾×2	4¼×2½
Each	**$2.60**	**3.25**	**3.90**	**5.00**	**6.50**

3940 **CASSEROLES, TRANSPARENT, FUSED SILICA.**

	a	b	c	d	e
Approximate capacity, cc.	30	75	150	200	350
Diameter × depth, inches	2×1	2¾×1⅜	3¼×1¾	3¾×2	4¼×2½
Each	**$4.25**	**8.30**	**12.20**	**14.75**	**20.75**

CENTRIFUGES



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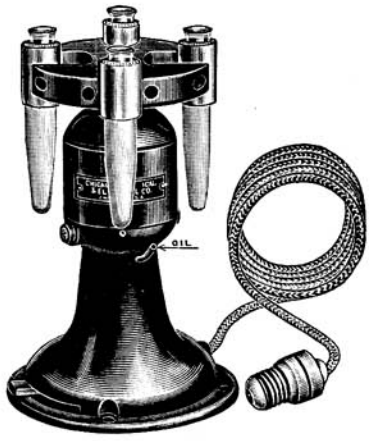
No. 3950



No. 3955

3945 **CENTRIFUGE, DOUBLE ARM, HAND DRIVE,** accurately cut phosphor-bronze gears with Babbitt metal bearing and ball-bearing rest. Entirely dust-proof. Relief clutch in handle makes it impossible to stop suddenly and disturb sediment in the glass tubes. New style holder eliminates danger of breaking the tubes. Speed, 2000 to 2500 R.P.M., obtained with ease and entire safety. Complete with two plain and two graduated 15-cc. glass tubes..... **$19.75**

CENTRIFUGE, ELECTRIC, for use on 110 or 220 volts direct current and alternating current circuits on direct current approximately 1500 R.P.M., on alternating current, approximately 1300 R.P.M. Prices include attachment cord and plug, with rotating head with metal tubes. Glass parts are extra as listed.

3948 ——, for 110 volts direct current. With Rheostat..... **55.00**

3950 ——, for 110 volts alternating current. Without Rheostat (not required)..... **55.00**

3957 **PLAIN GLASS TUBES,** 15 cc. for above centrifuges.....Each **.15**

3958 **GRADUATED GLASS TUBES,** 15 cc. for above centrifuges.....Each **.55**

3952C **RUBBER CAPS** for above tubes.....Each **.15**

3954 **CENTRIFUGE, VENTILATED MOTOR, ELECTRIC, double arm, ball-bearing support for armature of motor,** current consumption ¾ ampere, maximum speed 1800 R.P.M. With speed regulating rheostat and two 15 cc. tubes. For 110 volts direct current..... **42.50**

3954A ——, for 110 volts, 60 cycle, alternating current..... **42.50**

3954B ——, for 220 volts direct current..... **48.00**

3954C ——, for 220 volts alternating current..... **48.00**

3955 ——, **four-tube head.** With speed-regulating rheostat and four 15-cc. tubes. For 110 volts direct current..... **47.50**

3955A ——, for 110 volts, 60 cycle, alternating current..... **47.50**

3955B ——, for 220 volts direct current..... **52.50**

3955C ——, for 220 volts alternating current..... **52.50**

CENTRIFUGE ACCESSORIES

3957 **PLAIN GLASS TUBE,** 15 cc..... **$0.15**

3958 **GRADUATED GLASS TUBE,** 15 cc..... **.55**

3959 **HAEMATOKRIT,** with tubes for examination of blood and sputum..... **7.50**

3970 **CHARCOAL BLOCKS** for blowpipe work.....Per dozen **1.15**

3975 **CHART, ATOMIC WEIGHT,** compiled by Dr. F. W. Clarke and reported to the American Chemical Society. Corrected to 1911. Length 62 inches; mounted on common rollers..... **4.50**

3976 **CHART, PERIODIC LAW,** according to Mendelejeff, on basis of O=16. Revised and corrected by Dr. F. W. Clarke, up to 1911. American nomenclature. Length 62 inches; mounted on common rollers..... **4.50**

3980 **CHIMNEY, STUDENTS' LAMP**..... **.20**

6895 **CHLORINE TUBE** (see Newell's "Descriptive Chemistry," Exp. 23, and "General Chemistry," Exp. 29)..... **1.00**

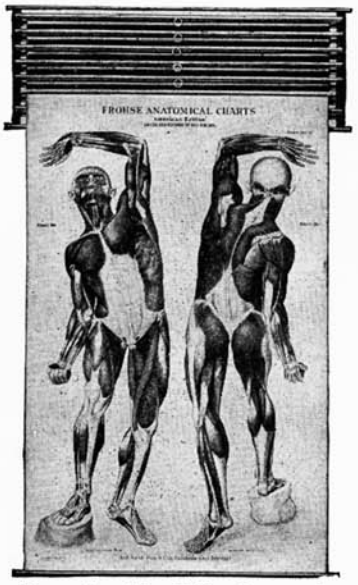


Illustration of the Utility Dust-proof Spring Roller Case with Plate drawn down.

AMERICAN FROHSE LIFE SIZE ANATOMICAL CHARTS

7 Plates. Size, 42×66 Inches

Edited, Revised and Augmented by
MAX BRODEL
Professor of Medical Drawing
Johns Hopkins University

This entirely new series of seven plates comprises seventeen illustrations, life-size or larger. They are lithographed in non-fading oil colors, natural colors being slightly accentuated to improve contrast. Durably cloth-backed and conveniently mounted. A complete set should be in every school where anatomy or physiology forms a part of the instruction.

	On Plain Mouldings		On Dust-proof Roller and Board		In Steel Spring Roller Case	
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Human Skeleton, Front and Back View	**3972A**	**$9.00**	**3973A**	**$11.00**	**3974A**	**$12.50**
The Muscles, Front and Back View	**3972B**	**9.00**	**3973B**	**11.00**	**3974B**	**12.50**
The Nervous System and Circulatory System	**3972C**	**9.00**	**3973C**	**11.00**	**3974C**	**12.50**
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3977 AMERICAN FROHSE ANATOMICAL CHARTS, set of seven charts, **Nos. 3972A-G** in Utility Spring Roller Case..... **$73.50**

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Skeleton and Structure of the Bone	**3990A**	**$2.75**	**3991A**	**$4.50**	**3992A**	**$5.40**
Joints, Ligaments and Cartilage	**3990B**	**2.75**	**3991B**	**4.50**	**3992B**	**5.40**
Muscular System and Structure of the Muscles	**3990C**	**2.75**	**3991C**	**4.50**	**3992C**	**5.40**
The Heart, Arterial and Capillary Blood Vessels	**3990D**	**2.75**	**3991D**	**4.50**	**3992D**	**5.40**
Veins, Organs of Respiration, Circulatory System	**3990E**	**2.75**	**3991E**	**4.50**	**3992E**	**5.40**
Lymphatics and Organs of Digestion	**3990F**	**2.75**	**3991F**	**4.50**	**3992F**	**5.40**
Brain, Nervous System and Skin	**3990G**	**2.75**	**3991G**	**4.50**	**3992G**	**5.40**
Organs of Sense and Voice	**3990H**	**2.75**	**3991H**	**4.50**	**3992H**	**5.40**
Showing Effects of Acohol on the Body	**3990I**	**2.75**	**3991I**	**4.50**	**3992I**	**5.40**
Showing Effects of Tobacco on the Body	**3990J**	**2.75**	**3991J**	**4.50**	**3992J**	**5.40**
Showing Cause for Typhoid Fever and Consumption	**3990K**	**2.75**	**3991K**	**4.50**	**3992K**	**5.40**
Showing Cause for Malaria and Ague	**3990L**	**2.75**	**3991L**	**4.50**	**3992L**	**5.40**
Showing Rats and Their Relation to Disease	**3990M**	**2.75**	**3991M**	**4.50**	**3992M**	**5.40**

3993 JOHNSTON'S ANATOMY AND PHYSIOLOGY CHARTS, set of eight (A to H) on heavy white coated paper, edges tape bound. Charts firmly mounted with stand.....Set **$12.75**

3993A ——, each chart hand mounted, cloth backed. Set of eight charts (A to H) with stand.....Set **19.75**

3993B JOHNSTON'S ANATOMY AND PHYSIOLOGY CHARTS. Complete set of 13 plates, each on heavy white coated paper, edges tape bound. Charts firmly mounted with stand .....Set **16.00**

3993C ——, each chart hand mounted, cloth backed. Complete set of 13 plates with stand.....Set **27.00**

3993D JOHNSTON'S ANATOMY AND PHYSIOLOGY CHARTS. Set of eight (A to H), each chart hand mounted, cloth backed. Two charts on a roller in Utility Spring Roller Case.....Set **25.50**

3993E ——, complete set of 13 plates, hand mounted, cloth backed, two charts on a roller in Utility Spring Roller Case..... **39.75**

No. 4000

No. 4002

No. 4004

No. 4006

No. 4008

No. 4013

No. 4015

No. 4017

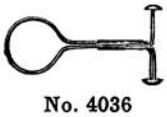
No. 4025

No. 4030

No. 4032

No. 4034

No. 4020


No. 4036

No. 4040

4000 **CLAMP, BURETTE, WITH ATTACHED CLAMP.** Check nut to adjust to any position, jaws open to 1½ inches **$0.40**

4002 **CLAMP, DOUBLE BURETTE,** closes automatically by means of coiled springs ..... **.95**

4004 **CLAMP, DOUBLE BURETTE, HOFFMAN'S,** opening 1¼ inches, length 7 inches **1.45**

4006 **CLAMP, BUNSEN'S,** for attaching to support rods of ring stands by means of **clamp holder.** Round jaws open to 1½ inches. Without **clamp holder** ..... **.45**

4008 **CLAMP, BUNSEN'S,** for attaching to support rods of ring stands by means of **clamp holder.** One flat and one **V-shaped** jaw. Opens to 2 inches. Without **clamp holder** ..... **.65**

4013 **CLAMP, BUNSEN'S QUICK ACTING, compound lever adjustment.** Jaws open to 1½ inches. Adjustment to full opening of the jaws by one-half turn of the turn buckle **2.40**

4015 **CLAMP, BUNSEN'S CONDENSER,** for attaching to support rod of ring stands by means of **clamp holder.** With swivel jaws which adapt themselves to regular or irregular shapes. Jaws open to 2½ inches. Without **clamp holder** **1.00**

4017 **CLAMP HOLDER** for use with any of above clamps ..... **.28**

4020 **CLAMPS, CABINET MAKERS',** of malleable iron, japanned, with ball and socket, swivel cap and screw.

	a	b	c
Open, inches	3	4	6
Each	**$0.90**	**1.45**	**2.00**

4022 **CLAMPS, HAND SCREW,** of wood, superior quality.

	a	b	c
Length of jaws, inches	7	8	10
Open, inches	3	4½	5½
Each	**$0.70**	**.85**	**1.00**

4025 **CLAMP, "CUT-OFF,"** of brass, nickel-plated, for tubes up to $\frac{3}{16}$-inch diameter ..... **.10**

4026 ——, for tubes up to $\frac{5}{16}$-inch diameter ..... **.12**

4030 **CLAMPS or SCREW COMPRESSORS, of brass, nickel-plated.** Can be placed upon tube without disconnecting the apparatus.

	a	b
Size, inches	½×¾	¾×1¼
Each	**$0.28**	**.35**

4032 **CLAMPS, HOFFMAN'S SCREW COMPRESSORS,** nickel-plated.

	a	b
Size, inches	½×¾	½×1
Each	**$0.25**	**.30**

4034 **CLAMP, LEVER SCREW COMPRESSOR,** for heavy walled tubing, of brass, nickel-plated, nicely finished with rounded edges. Size, ½ inch ..... **.50**

4036 **CLAMPS, MOHR'S PINCHCOCKS,** of brass, nickel-plated.

	a	b	c
	Small	Medium	Large
Length, inches	2¼	2¾	3¼
Each	**$0.13**	**.15**	**.18**

4040 **CLAMP, TEST TUBE,** of spring wire. Will hold test tubes from ½ to 1½ inches diameter. Will not burn ..... **.10**

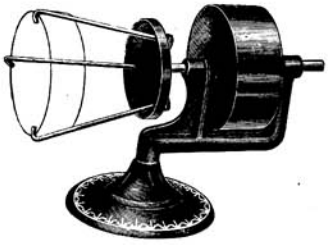
6305 **CLAY PIPES** ..... Per dozen **.50**

HARCOURT CLINOSTATS

STUDENTS' — ADVANCED

No. 4050

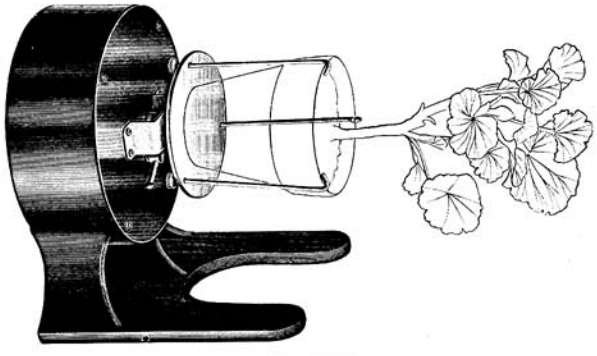
Showing Pot mounted vertically



No. 4050

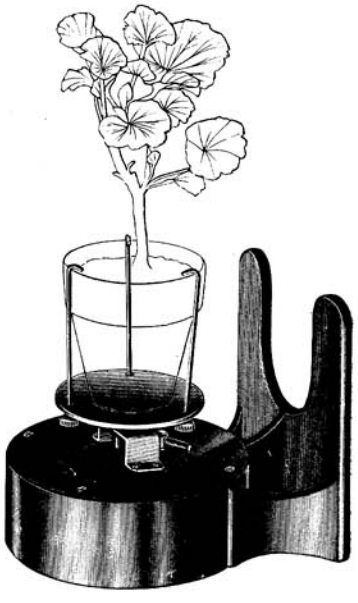
Showing Pot mounted horizontally

4050 HARCOURT STUDENTS' CLINOSTAT for small pots or especially for seeds growing in moss. Consists of a 24-hour clock enclosed in a practically dust and moisture-proof case of cast metal. Designed so that shaft may be used horizontally or vertically..... **$23.50**



No. 4052

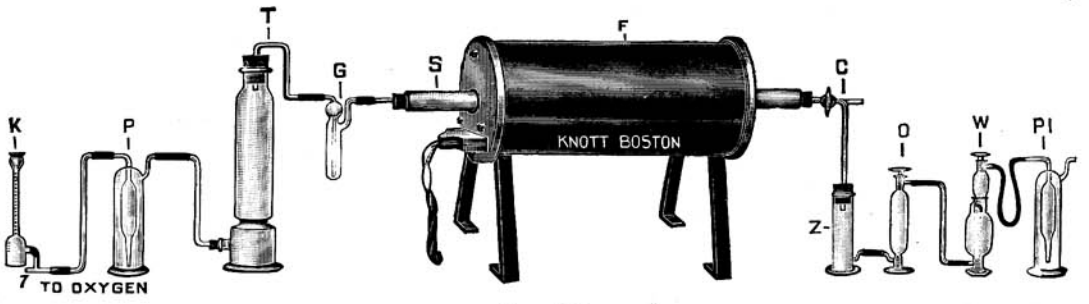
Showing Pot mounted horizontally



No. 4052

Showing Pot mounted vertically

4052 HARCOURT ADVANCED CLINOSTAT for pots up to 3 inches horizontally or larger vertically or for seeds growing in moss. This clinostat consists essentially of an 8-day clock enclosed in a practically dust and moisture-proof casing of cast metal. A 3-inch pot is recommended, as the instrument works best with this size. A 4-inch pot may be used, however, especially in the vertical position. Complete with set of clamps for holding pot as illustrated..... **36.75**



No. 4055

4065 **COMBUSTION APPARATUS, FLEMING'S,** for the rapid determination of carbon in all grades of steel by direct combustion. (A steel sample may be accurately analyzed within ten minutes.) Complete as illustrated with **No. 5513** Electric Furnace and Rheostat and **Nos. 4055A** to **4055F, 5705, 6868M** and **6661** **$71.85**

4055A	**MERCURY PRESSURE GAUGE** (K)	**$2.00**
4055B	**WASHING BOTTLE** (P)	**1.50**
4055C	**MERCURY VALVE** (G)	**.75**
4055D	**ZINC JAR** (Z)	**.75**
4055E	**PHOSPHORIC ANHYDRIDE JAR** (O)	**2.75**
4055F	**FLEMING ABSORPTION TUBE** (W). With this tube there is no possibility of CO_2 or moisture escaping, even though the oxygen current passes at the rate of 600 cc. per minute. One filling of this tube will last for 75 combustions	**3.50**
5705	**CALCIUM CHLORIDE JAR** (T)	**1.75**
6868M	**SILICA TUBE,** 30 inches long, 22 mm. diameter (S)	**8.45**
6661	**TWO-WAY STOP COCK** (C)	**2.00**
5511	**ELECTRIC TUBE FURNACE without Rheostat**	**33.35**
5513	**ELECTRIC TUBE FURNACE with Rheostat**	**46.65**

4065 **COMBUSTION BOATS, ALUNDUM.** (See index, **"Alundum Ware,"** for characteristics.) Valuable for all kinds of determinations involving combustions at high temperatures, particularly well suited for conditions met in the determination of carbon in iron and steel. Wall, 1/16 inch.

	a	b	c	d	e
Length, inches	3½	3¾	4½	5	5½
Width, inches	½	⅝	⅝	¾	½
Height, inches	5/16	⅜	7/16	7/16	5/16
Each	**$0.33**	**.40**	**.45**	**.45**	**.45**

4067 **COMBUSTION BOAT SHIELDS, ALUNDUM** (see index, **"Alundum Ware,"** for characteristics). For protecting combustion boats from the spattering of overheated metal. Wall 1/32-inch, length 4½ inches (114 mm.), bore 11/16 inch (18 mm.) **3.30**

4067b ——, length 5½ inches (140 mm.), bore 13/16 inch (21 mm.) **3.30**

4069 **COMBUSTION BOATS, PORCELAIN,** glazed inside and outside.

	a	b	c	d
Length, mm.	60	76	88	97
Width, mm.	10	11	12	18
Each	**$0.28**	**.33**	**.35**	**.37**

4071 **COMBUSTION BOATS, FUSED SILICA.** (See index, **"Fused Silica Ware,"** for characteristics.)

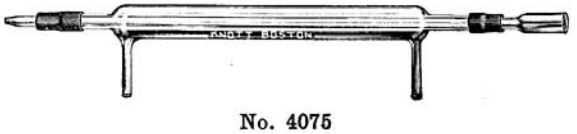
	a	b	c	d	e
Length × width × depth, inches	1¾×½×5/16	3×½×5/16	3×⅝×⅜	4×⅝×⅜	6×½×½
Each	**$0.75**	**1.10**	**1.25**	**1.65**	**2.20**

4072 **COMBUSTION BOATS, TRANSPARENT, FUSED SILICA.**

	a	b	c	d	e
Length × width × depth, inches	1¾×½×5/16	3×½×5/16	3×⅝×⅜	4×⅝×⅜	6×½×½
Each	**$2.10**	**3.80**	**4.15**	**5.20**	**7.60**

Above furnished on order.

COMBUSTION FURNACES. See **Furnaces.**



No. 4075

4075 **CONDENSERS, LIEBIG'S, GLASS,** with rubber connections and adapters.

	a	b	c	d
Length, inches	12	15	18	24
Each	**$1.20**	**1.50**	**1.65**	**2.00**

4076 ——, **"PYREX" GLASSWARE.** (See index, **"Pyrex" Glassware** for characteristics.)

	b	c	d
Length, inches	12	20	24
Each	**$2.90**	**4.00**	**4.50**

4077 **CONDENSER, LIEBIG'S, METAL,** for the distillation of liquids, made entirely of brass, highly polished. Length 30 inches; diameter 1⅛ inches. This form prevents breakage **6.10**

90-310 **CONNECTORS, DOUBLE** ..... Each **.18**

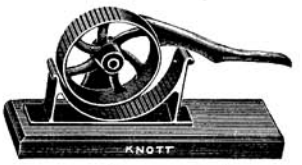
90-315 **CONNECTORS, TRIPLE** ..... Each **.35**

No. 5001

No. 5003

No. 5005

No. 5017



Nos. 5014 and 5015

No. 5013

CORKS, REGULAR LENGTH, TAPERED.

	Size Nos.		0	1	2	3	4	5
	Length, inches		3/8	1/2	1/2	1/2	1/2	5/8
	Diameter large end, inches		3/8	7/16	1/2	9/16	5/8	11/16
4095	**Regular Quality,**	Per 10	**$0.03**	**.04**	**.05**	**.06**	**.06**	**.07**
		Per 100	**.22**	**.25**	**.32**	**.35**	**.38**	**.45**
4096	**Best Quality, XXXX,**	Per 10	**.06**	**.08**	**.10**	**.12**	**.12**	**.14**
		Per 100	**44**	**.50**	**.64**	**.70**	**.76**	**.90**
	Size Nos.		6	7	8	9	10	11
	Length, inches		5/8	3/4	3/4	3/4	1	1
	Diameter large end, inches		3/4	13/16	7/8	15/16	1	1 1/16
4095	**Regular Quality,**	Per 10	**.08**	**.09**	**.10**	**.12**	**.14**	**.15**
		Per 100	**.50**	**.55**	**.66**	**.80**	**.90**	**1.00**
4096	**Best Quality, XXXX,**	Per 10	**.16**	**.18**	**.20**	**.24**	**.28**	**.30**
		Per 100	**1.00**	**1.10**	**1.32**	**1.60**	**1.80**	**2.00**
	Size Nos.		12	13	14	15	16	17
	Length, inches		1	1	1	1	1	1
	Diameter large end, inches		1 1/8	1 3/16	1 1/4	1 5/16	1 3/8	1 7/16
4095	**Regular Quality,**	Per 10	**.16**	**.17**	**.18**	**.20**	**.22**	**.26**
		Per 100	**1.10**	**1.16**	**1.32**	**1.52**	**1.95**	**2.04**
4096	**Best Quality, XXXX,**	Per 10	**.32**	**.34**	**.36**	**.40**	**.44**	....
		Per 100	**2.20**	**2.32**	**2.64**	**3.00**	**3.90**	....
	Size Nos.		18	19	20	22	24	26
	Length, inches		1	1	1	1	1	1
	Diameter, large end, inches		1 1/2	1 9/16	1 5/8	1 3/4	1 7/8	2
4095	**Regular Quality,**	Per 10	**.30**	**.32**	**.36**	**.48**	**.55**	**.70**
		Per 100	**2.25**	**2.40**	**2.64**	**3.35**	**4.20**	**4.95**
4096	**Best Quality, XXXX,**	Per 10	**.60**	....	**.72**	....	....	....
		Per 100	**4.50**	....	**5.20**	....	....	....

4097 **CORKS, SPECIE, FLAT or JAR, regular quality,** 5/8 inch thick.

	a	b	c	d	e	f	g	h
Diameter, large end, inches	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4
Per 10	**$0.16**	**.22**	**.32**	**.40**	**.50**	**.60**	**.75**	**.95**

4099 **CORKS, ASSORTED, Regular Quality, Regular Length, tapered, Nos. 0 to 11** ..... Per 100 **$0.60**

CORKS, RUBBER. See **Rubber Stoppers.**

5001 **CORK BORERS,** of hard metal with sharp cutting edge; polished, in sets with punch.

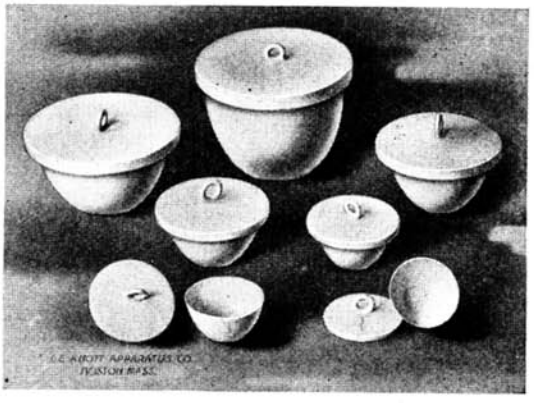
	a	b	c	d
No. in set	3	6	9	12
Per set	**$0.90**	**1.60**	**2.75**	**3.95**

5003 **CORK BORERS,** of hard drawn metal with sharp cutting edge, each borer with handle.

	a	b	c	d
No. in set	3	6	9	12
Per set	**$1.25**	**2.35**	**4.00**	**5.75**

5005 **CORK BORER SHARPENER,** a steel blade, and cone of brass, wood handle **$2.00**
5007 **CORK KNIFE,** good steel blade, wood handle ..... **.25**
5010a **CORK MAT, 4 inches diameter,** for supporting beakers, flasks, etc. ..... **.20**
5010b **——, 6 inches diameter** ..... **.30**
5013 **CORK PRESS, lever form,** japanned **1.00**
5014 **CORK PRESS, ROTARY, wheel form,** taking corks up to 3/4 inch diameter, japanned **2.25**
5015 **——,** taking corks up to 1 1/4 inches diameter, japanned **2.50**
5017 **CORK SCREW,** excellent quality, wood handle ..... **.50**
5020 **CORK SHEET** for lining insect boxes and cabinets, 9×30 cm. × 5 mm. thick ..... **.25**

COVER GLASSES. See **Nos. 5985** to **5989.**



5030 **CRUCIBLES, ALUNDUM.** (See index, "**Alundum Ware,**" for characteristics.) For general laboratory use where an ignition of carbonaceous material is involved. Without covers.

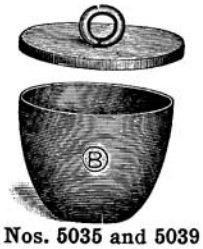
	a	b	c	d	e	f	g	h	i
Diameter at top, inches	1 1/16	1 1/16	1 1/2	1 1/2	1 5/8	1 7/8	1 7/8	2 1/8	2 1/2
Height, inches	1 3/32	1 1/4	1 3/16	1 1/2	1 5/8	1 5/8	1 7/8	1 3/4	3
Capacity, cc.	10	15	20	25	30	40	70	80	95
Each	**$0.38**	**.38**	**.38**	**.38**	**.45**	**.45**	**.55**	**.72**	**1.45**

5031 **CRUCIBLE COVER, ALUNDUM,** diameter 1½ inches **$0.84**

5031A ——, diameter 1⅞ inches . . . . . **.84**

5033 **CRUCIBLES, GRAPHITE,** Dixon's genuine. Capacities given are actual total, not working capacities, which are variable.

	a	b	c	d	e
Capacity, ounces	2	4	8	12	16
Height × diameter, inches	2 1/4 × 1 13/16	2 15/16 × 2 3/8	3 5/8 × 3 1/4	4 1/2 × 3 3/4	5 1/4 × 4 1/4
Each	**$0.75**	**.75**	**1.00**	**1.10**	**1.30**



Nos. 5035 and 5039

5035 **CRUCIBLES, SHEET IRON, with covers.**

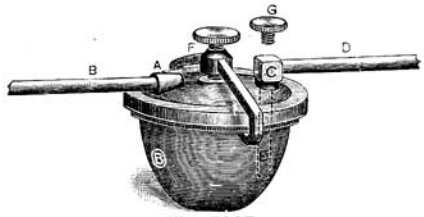
	a	b	c	d
Capacity, cc.	20	50	100	200
Each	**$0.26**	**.38**	**.47**	**.65**

5039 **CRUCIBLES, SHEET NICKEL, with covers.**

	a	b	c	d
Capacity, cc.	20	30	50	100
Each	**$1.10**	**1.35**	**1.45**	**2.90**

CRUCIBLES, PLATINUM. See **Platinum Ware.**

5037 **CRUCIBLE, SKIDMORE'S IRON,** for making oxygen from MnO_2, calcination of chalk with recovery of the expelled CO_2, manufacture of soda from cryolite, preparation of ammonia, destructive distillation of coal, wood or other organic substance, or for any use in which the materials employed or evolved do not act destructively on hot iron. Can be used equally well as an open crucible, closed crucible or retort. Capacity 1½ ounces **$1.75**



No. 5037

5040 **CRUCIBLES, PORCELAIN, high form,** glazed inside and outside with exception of outside bottom surface. Each crucible with cover.

Size No.	00	0	1	2
Diameter rim × diameter bottom × height, mm.	30 × 14 × 25	35 × 17 × 27	41 × 20 × 35	52 × 25 × 43
Capacity, cc.	10	15	30	57
Each	**$0.22**	**.26**	**.40**	**.52**

5042 **——, low form.**

Size No.	00	0	1	2	3	4	5
Diameter rim × diameter bottom × height, mm.	37 × 15 × 21	41 × 15 × 25	46 × 18 × 29	56 × 18 × 36	67 × 23 × 44	81 × 29 × 52	96 × 35 × 65
Capacity, cc.	12	17	30	50	90	145	265
Each	**$0.26**	**.33**	**.42**	**.58**	**.74**	**.86**	**1.05**

5045 **CRUCIBLES, GOOCH, PORCELAIN.** Thin wall, bottom unglazed, outside and inside glazed.

	a	b	c
Approximate capacity, cc.	10	25	35
Diameter at top × diameter at bottom × height, mm	27×18×30	35×22×40	40×25×43
Each	**$0.40**	**.54**	**.60**

5046 **GLASS SUPPORTING FUNNELS for above.**

	a	b	c
Each	**$0.40**	**.55**	**.70**

5048 **CRUCIBLES, FUSED SILICA.** (See index, "**Fused Silica Ware,**" for characteristics.) **Glazed.** Berlin porcelain shape. Measurements given are outside measurements.

	a	b	c	d	e	f
Approximate capacity, cc.	4	15	25	40	65	145
Diameter × height, inches	$1\frac{1}{16}\times\frac{3}{4}$	$1\frac{5}{8}\times1$	$1\frac{7}{8}\times1\frac{1}{8}$	$2\frac{1}{4}\times1\frac{7}{16}$	$2\frac{5}{8}\times1\frac{3}{4}$	$3\frac{3}{16}\times2$
Crucibles, each	**$0.72**	**.94**	**1.10**	**1.28**	**1.82**	**2.25**
Lids to fit, each	**.60**	**.60**	**.72**	**.94**	**.94**	**.94**

5048T ——, same as above, but **transparent.**

	a	b	c	d	e	f
Approximate capacity, cc.	4	15	25	40	65	145
Diameter × height, inches	$1\frac{1}{16}\times\frac{3}{4}$	$1\frac{5}{8}\times1$	$1\frac{7}{8}\times1\frac{1}{8}$	$2\frac{1}{4}\times1\frac{7}{16}$	$2\frac{5}{8}\times1\frac{3}{4}$	$3\frac{3}{16}\times2$
Crucibles, each	**$1.40**	**2.75**	**3.50**	**5.20**	**6.95**	**9.00**
Lids to fit, each	**1.40**	**2.25**	**2.75**	**4.15**	**4.70**	**6.95**

5049 **CRUCIBLES, FUSED SILICA.** (See index, "**Fused Silica Ware,**" for characteristics.) **Unglazed.** Measurements are outside measurements.

	a	b	c	d	e	f	g	h	i
Approximate capacity, cc.	350	500	925	1400	1875	2500	5000	8000	22500
Diameter at top, inches	$3\frac{3}{4}$	4	$4\frac{1}{2}$	5	$5\frac{7}{8}$	$6\frac{1}{4}$	$7\frac{3}{4}$	$10\frac{1}{8}$	12
Height, inches	$4\frac{3}{8}$	$4\frac{1}{2}$	$6\frac{1}{8}$	$7\frac{1}{2}$	$7\frac{3}{4}$	$8\frac{3}{8}$	$10\frac{1}{4}$	$12\frac{3}{4}$	20
Each	**$3.25**	**3.25**	**4.60**	**5.55**	**5.95**	**7.40**	**11.15**	**14.75**	**25.80**

5050 **CRUCIBLES, FUSED SILICA.** (See index, "**Fused Silica Ware,**" for characteristics.) **Glazed.** Platinum shape.

	a	b	c
Approximate capacity, cc.	50	20	30
Top diameter × height, inches	2×2	$1\frac{3}{8}\times1\frac{3}{8}$	$1\frac{11}{16}\times1\frac{1}{2}$
Crucibles, each	**$1.84**	**1.50**	**1.50**
Lids to fit, each	**.72**	**.60**	**.60**

5050T ——, same as above, but **transparent.**

	a	b	c
Approximate capacity, cc.	50	20	30
Top diameter × height, inches	2×2	$1\frac{3}{8}\times1\frac{3}{8}$	$1\frac{11}{16}\times1\frac{1}{2}$
Crucibles, each	**$6.60**	**3.10**	**3.50**
Lids to fit, each	**3.50**	**2.25**	**2.65**

5051 **CRUCIBLE, FUSED SILICA, GOOCH,** $\frac{3}{4}$-inch hole in bottom, without disc. (See index, "**Fused Silica Ware,**" for characteristics.) Outside measurements — height $1\frac{5}{8}$ inches (41 mm.), diameter at top $1\frac{5}{8}$ inches (41 mm.). Glazed **$1.25**

5052 **CRUCIBLE, FUSED SILICA, SPECIAL.** (See index, "**Fused Silica Ware,**" for characteristics.) Glazed. Outside measurements — height $3\frac{3}{16}$ inches (81 mm.), diameter at top $2\frac{7}{8}$ inches (73 mm.) **6.95**

5055 **CRUCIBLE, FILTER, ALUNDUM,** for the separation of liquids from solids in laboratory practice. Special glass funnels and rubber gaskets are necessary to give the proper fit between the container and filtering medium. Three degrees of porosity may be obtained — 36.9 per cent., 40.7 per cent. and 47.4 per cent. We carry in stock, however, 40.7 per cent. only. Diameter $1\frac{3}{8}$ inches, height $1\frac{1}{2}$ inches, capacity 25 cc. . . . . **.40**

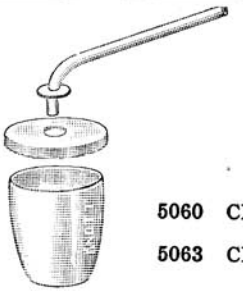
5055A **GLASS SUPPORTING FUNNEL,** for use with **Nos. 5055** and **5055B** . . . . . **.65**

5055B **RUBBER GASKET** for use with **Nos. 5055** and **5055A** . . . . . **.06**

5056 **CRUCIBLE, FILTER, ALUNDUM,** same as **No. 5055,** but $1\frac{5}{8}$ inches diameter, $1\frac{11}{16}$ inches high and 35 cc. capacity . . . . . **.45**

5056A **GLASS SUPPORTING FUNNEL** for use with **Nos. 5056** and **5056B** . . . . . **.78**

5056B **RUBBER GASKET** for use with **Nos. 5056** and **5056A** . . . . . **.06**



No.5060

No. 5063

No. 5067

Nos. 5075 and 5076

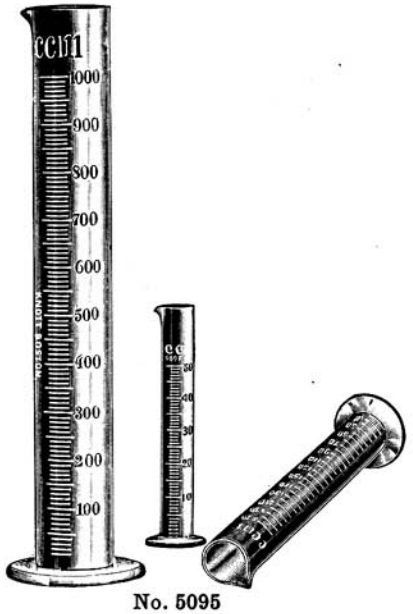
5060 CRUCIBLE, ROSE'S, with perforated cover and delivery tube, unglazed, vitreous. Capacity 30 cubic cms. **$1.40**

5063 CRUCIBLES, SAND, round form with lip.

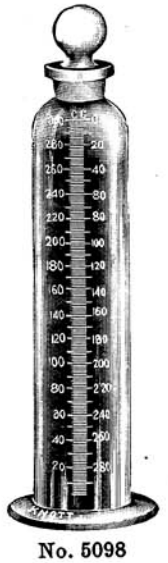
	a	b	c	d	e
Height, inches.	2⅝	3	3½	4	4½
Diameter, inches. . .	1⅝	1⅞	2¼	2⅜	2⅞
Per dozen.	**$1.50**	**1.75**	**2.00**	**2.25**	**2.60**

5065A CRUCIBLE BLOCKS, 6×6×1 inch, ½-inch hole. . . . . Per dozen **1.50**
5065B ——, 4×4×½ inch, ½-inch hole. . . . . Per dozen **1.50**
5065C ——, 6×6×¾ inch, ½-inch hole. . . . . Per dozen **1.50**
5067 CRUCIBLE FUNNEL, of glass, according to Dr. Lyman C. Newell. . . . . **.30**
5069 CRUCIBLE RUBBER TUBING for connecting Gooch Crucible and Funnel. . . . . Per foot **.30**
5075 CRUCIBLE TONGS, steel, double bend, 9 inch. . . . . **.25**
5076 CRUCIBLE TONGS, steel, nickel-plated, double bend, 9 inch. . . . . **.40**
CULTURE TUBES. See **Tubes, Culture.**

No. 31–250



No. 5095



No. 5098

CUPS, POROUS.

Cat. No.	91–15b	91–92	91–167	91–77
Diameter, inches. . .	1½	2	2½	3
Height, inches.	3	4	5	7
Each.	**$0.30**	**.35**	**.45**	**.55**

31–250 CYLINDERS or HYDROMETER JARS for use where a tall jar of small diameter is desired. Of clear white glass with foot and rim.

	a	b	c	d	e
Size, inches.	12×1½	12×2	15×2	15×3	18×3
Each.	**$1.15**	**1.25**	**1.75**	**2.00**	**3.00**

5095 CYLINDERS, GRADUATED, of glass, broad base, with lip, graduated in cubic centimeters.

	a	b	c	d	e	f	g
Capacity, cc.	10	25	50	100	250	500	1000
Each.	**$0.42**	**.60**	**.65**	**.70**	**1.00**	**1.35**	**2.00**

5096 CYLINDERS, GRADUATED, double graduations, reading up and down, of glass, broad base, with lip. Graduated in cubic centimeters.

	a	b	c	d	e	f
Capacity, cc.	25	50	100	250	500	1000
Each.	**$0.60**	**.70**	**.75**	**1.15**	**1.60**	**2.20**

5098 CYLINDERS, MIXING, GRADUATED AND STOPPERED, double graduations, serviceable when making standard solutions. Of glass, broad base, round glass stoppers, graduated in cubic centimeters.

	a	b	c	d	e	f	g
Capacity, cc.	25	50	100	200	250	500	1000
Each.	**$1.20**	**1.45**	**1.50**	**1.90**	**2.10**	**3.15**	**4.20**

No. 5112A

No. 5113

No. 5118

No. 6291

DEFLAGRATING SPOONS. See **Spoons, Deflagrating.**

5112 **DESICCATOR, SCHEIBLER'S, "PYREX" GLASS.** (See index **"Pyrex" Glassware** for characteristics.) Diameter, inside, 8 inches. With cover and knob like **No. 5118**.... **$12.75**

5112A ——, cover with neck to take rubber stopper K30..... **13.90**

5113 ——, cover with ground-in "Pyrex" glass stopcock..... **20.00**

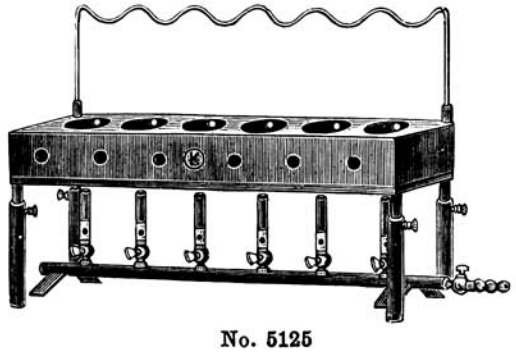
5118A **DESICCATORS, SCHEIBLER'S,** of glass, with covers ground air-tight. Diameter 4 inches..... **1.50**

5118B ——, diameter 6 inches..... **2.25**

5120 **DESICCATOR PLATES, glazed,** on three small feet, for use in above.

	a	b
Diameter, mm.....	95	140
No. of holes.....	3	5
Each.....	**$1.00**	**1.70**

6291 **DIAMOND** for writing on glass. Excellent quality..... **3.50**



No. 5125

5125 **DIGESTING SHELF, KJELDAHL'S, oblong form of sheet iron,** with rod to support the flasks. The shelf is supported on adjustable legs. Size 24 inches long, 5½ inches wide, 9½ inches high. Complete with six burners, each with stopcock..... **27.50**

5127 **DIGESTING SHELF, ELECTRICALLY HEATED, KJELDAHL'S, oblong form of sheet iron,** with rod to support the flasks. Each heater, 3½ inches in diameter, is a unit, and either one or all may be used at one time, as desired. Size 24 inches long, 5½ inches wide, 9 inches high. With six heaters. **85.00**

5134 **DISHES, AGATE WARE.**

	a	b	c
Dimensions, inches.....	6⅛×1½	7×1⅝	8½×2
Capacity, quarts.....	½	1	2
Each.....	**$0.35**	**.45**	**.60**

No. 5136

5136 **DISHES, CRYSTALLIZING.** Of clear white glass, flat bottoms, straight sides.

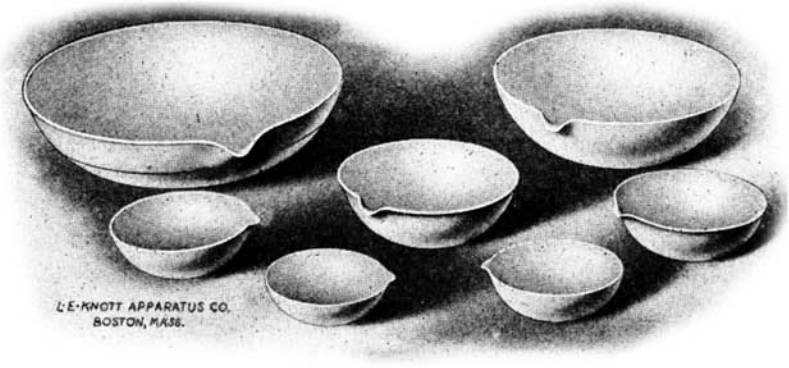
	a	b	c	d	e
Diameter, inches.....	2	3	4	5	6
Each.....	**$0.18**	**.24**	**.32**	**.45**	**.60**

5137 ——, **"PYREX" GLASS.** (See index **"Pyrex" Glassware** for characteristics.)

	a	b	c	d	e	f
Diameter, mm.....	70	100	125	150	170	190
Height, mm.....	50	50	65	75	90	100
Each.....	**$0.50**	**.60**	**.95**	**1.28**	**1.40**	**1.65**

No. 5137a is recommended for Tanners' use.

EVAPORATING DISHES



5138 DISHES, EVAPORATING, "PYREX" GLASS. (See index **"Pyrex" Glassware** for characteristics.)

	a	b	c	d	e	f
Diameter, mm.	80	90	105	125	150	200
Height, mm.	45	50	55	65	80	100
Each	**$0.40**	**.45**	**.50**	**.84**	**1.10**	**1.45**

5139 DISHES, EVAPORATING, PURE SHEET NICKEL, with lip, polished.

	a	b	c
Diameter, inches	2	2¾	3½
Capacity, cc.	40	100	200
Each	**$1.30**	**1.80**	**2.65**

5141 DISHES, EVAPORATING, PORCELAIN, excellent quality, well adapted to general chemical work in the laboratory. Thin, uniform, glazed inside and outside.

	a	b	c	d	e	f
Size, No.	00	0	1	2	3	4
Diameter, cm.	7	8	8½	9	10	11
Capacity, cc.	60	80	100	140	175	210
Each	**$0.24**	**.27**	**.40**	**.46**	**.53**	**.60**
	g	h	i	j	k	l
Size, No.	5	6	7	8	9	10
Diameter, cm.	12	14½	18½	21½	26½	30½
Capacity, cc.	300	385	765	1285	2200	3250
Each	**$0.73**	**.93**	**1.20**	**1.60**	**2.40**	**4.00**

5145 DISHES, EVAPORATING, FUSED SILICA. (See index, **"Fused Silica Ware,"** for characteristics.) **Glazed.** Measurements given are inside measurements.

	a	b	c	d
Diameter, inches	2	2¾	3¼	3½
Depth, inches	13/16	1	1 3/16	⅞
Capacity, cc.	25	45	80	90
Each	**$1.50**	**1.65**	**1.82**	**2.05**
	e	f	g	h
Diameter, inches	3⅞	4¼	5⅜	5⅛
Depth, inches	1 3/16	1¾	2¼	2½
Capacity, cc.	100	200	400	500
Each	**$2.40**	**2.80**	**6.80**	**7.05**

5146 DISHES, EVAPORATING, FUSED SILICA. (See index, **"Fused Silica Ware,"** for characteristics.) **Unglazed.**

	a	b	c	d	e	f	g
Diameter, inches	5⅜	5⅛	6	6	7	7	8
Depth, inches	2¼	2½	2½	3	2¾	3¾	3¼
Capacity, cc.	400	500	600	700	800	1200	1400
Each	**$4.25**	**4.45**	**4.60**	**5.15**	**5.55**	**5.70**	**6.50**
	h	i	j	k	l	m	n
Diameter, inches	8	9	9	12¼	15½	18	18
Depth, inches	4¼	3½	4¾	5¼	4	7	8½
Capacity, cc.	1800	1800	2500	3000	3000	15,000	22,500
Each	**$7.35**	**8.35**	**9.30**	**13.90**	**16.50**	**19.75**	**21.00**

No. 5148

No. 5150

5148 DISHES, FILTER, ALUNDUM. (See index, **"Alundum Ware,"** for characteristics.) Porosity 40.7 per cent. carried in stock. Porosities of 36.9 per cent. and 47.4 per cent. can be obtained at same prices.

	a	b	c
Dimensions, inches	2½×1	4×2	5⅝×2
Capacity, cc.	50	300	400
Each	**$1.00**	**1.40**	**2.20**

5150 DISH, INCINERATING, ALUNDUM. (See index, **"Alundum Ware,"** for characteristics.) **Rectangular form.**

	a	b	c
Dimensions, inches	4⅝×4⅝×1	9¾×4×¾	12⅜×6⅜×2 3/16
Each	**$1.65**	**3.30**	**6.65**

5151 ——, **round form,** 2¾ inches diameter, ⅝ inch deep. **$0.55**

No. 5155

No. 5157

No. 5159

No. 5169a-c

No. 5169d

5154 DISHES, LEAD, of heavy sheet lead.

	a	b	c
Diameter, inches	2	3	4
Each	**$0.15**	**.20**	**.32**

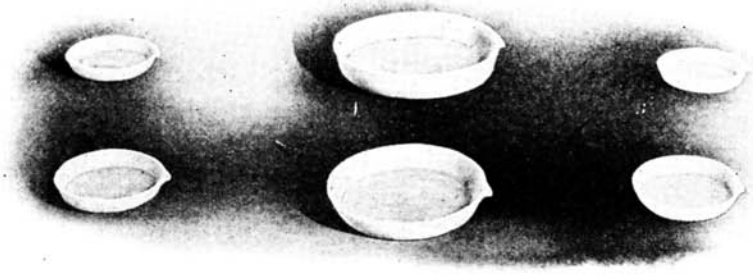
5155 DISH, LEAD, rectangular, for etching . . . . . **.40**

5157 DISHES, MILK, ALUMINUM, flat bottom, straight sides.

	a	b	c
Diameter, inches	2	3	4
Each	**$0.25**	**.40**	**.60**

5159 DISHES, PETRI or DOUBLE, glass cover, diameter 10 centimeters . . . . . **.32**

5161 DISHES, PETRI or DOUBLE, porous porcelain cover, according to Boston Board of Health. Diameter 10 centimeters . . . . . **.40**



No. 5165

5165 DISHES, FUSED SILICA. (See index, **"Fused Silica Ware,"** for characteristics.) Flat, with lip, **glazed.**

	a	b	c	d
Approximate capacity, cc.	20	30	75	150
Diameter, inches	2½	2⅞	3¾	4⅞
Depth, inches	½	½	11/16	13/16
Each	**$1.65**	**1.82**	**2.05**	**2.75**

5169 DISHES, STENDER or PREPARATION, of clear white glass, covers grooved and ground on.

	a	b	c	d
Diameter, inches	1⅜	2	2⅜	3⅜
Height, inches	¾	1	1⅛	3½
Each	**$0.22**	**.30**	**.40**	**.45**

DISSECTING INSTRUMENTS

No. 5181

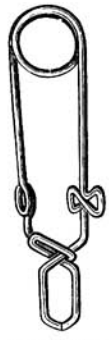
No. 5196

No. 5182

No. 5184

No. 5186

No. 5188



No. 5192

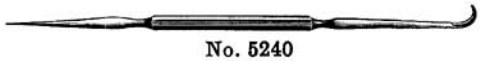
No. 5201

No. 5208

No. 5214

No. 5220

No. 5238



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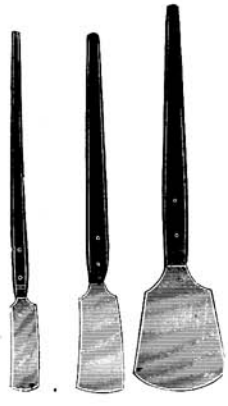
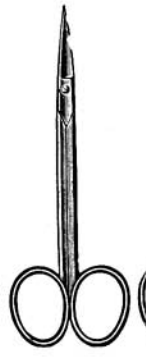
No. 5218

No. 5216



No. 5230 No. 5232 No. 5234

No. 5224



No. 5226

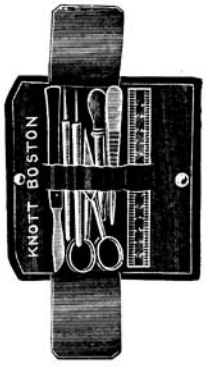
No. 5227

5180	**BLOWPIPE, 2½ inches, for inflating arteries,** etc.	$0.15
5181	**DISSECTING PAN, BUSSEY'S,** 7½×11 inches, with black wax	.60
5182	**FORCEPS, steel, 5-inch,** nickel-plated, straight, heavy corrugated points, corrugated handles	.55
5184	**FORCEPS, FINE, STRAIGHT, steel, 4-inch,** nickel-plated, corrugated points, corrugated handle, with guide pin	.65
5186	**FORCEPS, FINE, CURVED, steel, 4-inch,** nickel-plated, corrugated points, corrugated handle, with guide pins	.95
5188	**FORCEPS, FINE POINTS,** plain, **4¼-inch,** smooth handles	.30
5192	**FORCEPS, COVER-GLASS, STEWART'S, 4½-inch,** nickel-plated steel wire	.25
5196	**HOOKS AND CHAINS,** triple hooks and connecting chains, nickel-plated	.18
5198	**NEEDLES, STRAIGHT, wood handle** Per dozen	.60
5199	**NEEDLES, BENT, wood handle** Per dozen	.60
5201	**NEEDLE HOLDER, bone handle** with **clamping holder** for straight or bent needles, 3½-inch	.20
5203	**NEEDLES, STRAIGHT,** for use with above holder Per dozen	.48
5204	**NEEDLES, BENT,** for use with above holder Per dozen	.48
5208	**RAZOR, SECTION,** folding handle, superior quality, 3-inch blade, one side flat, straight edge	2.40
5214	**SAW, BONE,** superior grade, 4 inches long	1.90
5216	**SCALPEL, 1¾-inch blade,** excellent quality steel, ebony handles riveted to the blade	.65
5217	——, **1¼-inch blade**	.60
5218	——, **1-inch blade**	.60
5220	**SCALPEL, CARTILAGE (Cartilage Knife),** 6½-inch, all steel; blade 2 inches long; corrugated handle	.75
5224	**SCISSORS, 4½-inch, medium heavy,** straight, fine cutting points	.75
5226	**SCISSORS, 4½-inch, fine sharp straight points;** heavy pattern	1.25
5227	**SCISSORS, 4½-inch, fine sharp curved points;** heavy pattern	1.25
5230	**SECTION LIFTER,** thin flexible blade, **1¾×⅜ inches,** ebony handle riveted to blade	.65
5232	——, blade, **1¾×¾ inches**	.70
5234	——, blade, **2×1⅛ inches**	.75
5238	**TENACULUM,** steel shank with sharp hook, ebony handle riveted to blade	.70
5240	**TENACULUM AND NEEDLE,** solid steel, sharp hook, sharp point	.50

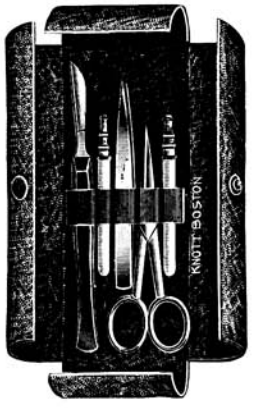
DISSECTING SETS

Our sets of dissecting instruments have been made up with great care. The instruments are of finely-tempered steel and the shapes and sizes chosen for the various sets have met with complete approval of teachers of the natural sciences.

The cases are of the folding pocket form with separate loops for each instrument. The **leatherette cases** are strong and durable. They are lined with cloth, with cloth flaps. The **leather cases** are made of black morocco and are lined with leather with chamois flaps to protect the instruments.



No. 5255



No. 5257

No. 5259

No. 5261

No. 5263

5255 **HARCOURT FIRST-YEAR STUDENTS' DISSECTING SET, one-fold leatherette case** containing ruler and six high-grade instruments as follows: 2 dissecting needles, forceps, scissors, scalpel and pipette . . . . . Set **$2.00**

5257 **HARCOURT ADVANCED STUDENTS' DISSECTING SET, one-fold leatherette case** containing five high-grade instruments — 2 bone-handled clamping needle holders with needle for each, forceps, scissors and scalpel . . . . . Set **2.25**

5259 **HARCOURT SUPERIOR DISSECTING SET, two-fold leatherette case** containing cartilage knife, scalpel, tenaculum, forceps, blowpipe, scissors and hooks and chains . . . . . Set **4.75**

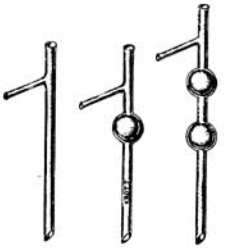
5261 **THE UNIVERSITY DISSECTING SET,** — morocco leather case, leather-lined, chamois flaps, containing the following extra fine-grade instruments: two bone-handled clamping needle holders, each with needle, fine-pointed curved forceps, fine-pointed scissors, medium scissors, blowpipe, hooks and chains, tenaculum, heavy forceps and three sizes of scalpels. Twelve instruments in case. . . . . Set **8.75**

5263 **HARCOURT RESEARCH DISSECTING SET, leatherette-covered case with clasp,** containing the following extra fine-grade instruments: cartilage knife, four sizes of scalpels, tenaculum, forceps, hooks and chains, blowpipe, scissors and bone saw. Eleven instruments in case. . . . . Set **9.00**

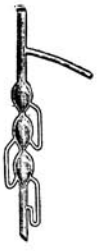
No. 5275

No. 5277

No. 5279



Nos. 5285 to 5285B



No. 5286

5275 **DISTILLING APPARATUS, HEAVY POLISHED COPPER,** for destructive distillation of heavy oils and other liquids or solids requiring high heat. The distillation may be made by live steam or by direct heat with or without agitation by hot air blown through, as desired. Capacity ½ gallon..... **$24.00**

5277 **DISTILLING APPARATUS, SALLERTON'S, POLISHED COPPER,** for determining percentage of alcohol in wine, beer, cider, etc. Capacity ½ pint..... **16.50**

5279 **DISTILLING APPARATUS, VACUUM, "PYREX" GLASS.** (See index, **"Pyrex" Glassware** for characteristics.) Complete as illustrated with dome and distilling tube..... **11.65**

5279A **——, without distilling tube**..... **8.35**

5415 **DISTILLATION FLASKS, FRACTIONAL,** with side tubes.

	a	b	c	d	e	f
Capacity, cc.....	15	30	125	250	500	1000
Each.....	**$0.25**	**.33**	**.45**	**.55**	**.68**	**1.10**

5416 **——, "PYREX" GLASS.** (See index, **"Pyrex" Glassware** for characteristics.) With side tube in middle of neck.

	a	b	c	d	e	f
Capacity, cc.....	100	200	250	500	1000	2000
Each.....	**$0.50**	**.60**	**.65**	**.78**	**1.30**	**1.80**

5418 **DISTILLATION FLASKS, ENGLER'S, "PYREX" GLASS.** (See index, **"Pyrex" Glassware,** for characteristics.) For fractional distillation of creosote and petroleum. Made to standard dimensions according to the American Society for Testing Materials and the United States Bureau of Mines.

	a	b	c
Capacity, cc.....	100	200	250
Each.....	**$0.65**	**.74**	**.78**

5285 **DISTILLATION TUBE, FRACTIONAL.** Plain, with side tube..... **.42**

5285A **——,** with one bulb..... **.66**

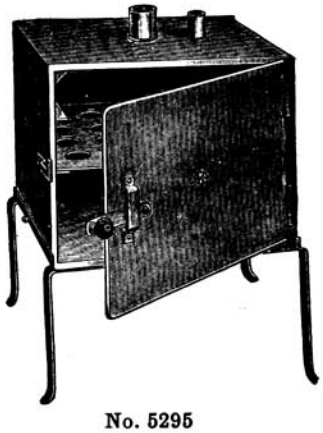
5285B **——,** with two bulbs..... **.81**

5286 **DISTILLATION TUBE, FRACTIONAL,** after Lebel and Henninger. With three bulbs..... **2.35**

5286A **——, with four bulbs**..... **3.95**

DRYING OVENS

These ovens are of polished copper, with tubulatures for thermometer and gas regulator. Extra sheet iron bottom, single and double wall, as listed below.



No. 5295

No. 5299

5295 **DRYING OVEN, single wall,** on iron stand 8 inches high, with set screw by which oven is held firmly. Inside dimensions, 6×8×6 inches deep. With one removable shelf..... **$9.00**

5297 **DRYING OVEN, double wall,** otherwise same as above. With one removable shelf..... **14.00**

5299 **DRYING OVEN, double wall,** same as **No. 5297,** but with the addition of **water bath top.** With one removable shelf..... **17.00**

5301 **DRYING OVEN, double wall,** same as **No. 5297,** but inside dimensions 8×10×8 inches high. With one removable shelf..... **17.75**

No. 5303

No. 5304

5303 **CONSTANT TEMPERATURE SINGLE WALL ELECTRIC DRYING OVEN, 10×10×12 inches. Bi-metallic temperature control.** Constant temperature maintained up to 160° C. Base, cast iron, aluminum painted; transite asbestos walls; cast aluminum door frame and shelf racks. Heating element is a removable wire wound resistance plate placed in the bottom of the oven. A switch is provided to turn the current "on" or "off" and a pilot lamp outside the oven enables the operator to quickly adjust the regulator to the desired temperature without opening the door. Adjustable ventilators are provided in the top and door, also an opening in the top for a thermometer. With two adjustable shelves, detachable cord and plug **$55.50**

5303A ——, **18×12×14 inches,** chamber accessible through **double doors** **77.75**

5303B **CONSTANT TEMPERATURE DOUBLE WALL ELECTRIC DRYING OVEN, 10×10×12 inches** high. Same as **No. 5303** but double-walled **66.75**

5303C ——, **18×16×9 inches** high **88.75**

5304 **FREAS' CONSTANT TEMPERATURE DOUBLE WALL ELECTRIC DRYING OVEN, 12×12×12 inches.** Constant temperature maintained up to 180° C. and guaranteed to remain constant indefinitely with a single degree variation. Walls of heavy transite asbestos with cast aluminum doors and door frames. Air space between walls filled with insulating material. A small tube electric lamp within the oven acts as a pilot and can be lighted at will so that the parts of the chamber can be inspected without opening the door. Adjustable ventilator on the side; opening in the top for a thermometer. Heating element, placed in the base, consists of a wire-wound resistance plate. Regulator made entirely of metal, and cannot get out of order. With two adjustable shelves, flexible cord and plug **150.00**

5304A ——, **on heavy cast-iron base with legs.** Chamber **16×14×16 inches,** otherwise same as **No. 5304** .. **272.25**

5304B ——, same as **No. 5304A,** but chamber **14×17×18 inches** **295.50**

5304C ——, same as **No. 5304A,** but chamber **26×14×22 inches** **366.50**

5304D ——, same as **No. 5304A,** but chamber **32×18×22 inches** **444.50**

5305 ——, same as **No. 5304,** but with **inside removable glass door** and **low-wattage heating plate** in addition to the regular heating plate. This change allows the oven to be used as a combination drying oven, incubator, dry sterilizer and paraffine bath. Designed to stand on the table **178.00**

5305A ——, **on heavy cast-iron base with legs.** Chamber **14×17×18 inches** **295.50**

5306 ——, for drying a large number of samples simultaneously or samples containing considerable moisture. This is the same oven as **No. 5304,** but provided with a flue in the back wall above which is placed a centrifugal fan driven by a motor supported on the outside of the oven. This arrangement provides a forced circulation of heated air and a forced withdrawal of moisture-laden air, thereby creating more perfect conditions and shortening the time for the drying operation. Size of chamber **12×12×12 inches.** With direct current motor **250.00**

5306A ——, same as **No. 5306,** but for alternating current **250.00**

5306B ——, same as **No. 5306,** but for temperatures up to 260° Centigrade. With direct current motor .. **272.25**

5306C ——, same as **No. 5306B,** but for alternating current **272.25**

5306D ——, same as **No. 5306,** but size of chamber **12×14×16 inches** for temperatures up to 180° Centigrade, and with direct current motor **366.50**

5306E ——, same as **No. 5306D,** but for alternating current **366.50**

No. 5308

No. 5309

5308 **FREAS' ELECTRIC VACUUM DRYING OVEN with Removable Vacuum Chamber.** Consists of a constant temperature drying oven **12×12×12 inches (No. 5304),** with a vacuum chamber of heavy bronze, 9 inches diameter by 9 inches deep, properly supported in the chamber of the oven proper. This vacuum chamber is provided with racks for shelves and four perforated metal shelves and with connections for vacuum and for passing through the chamber a current of warm air, hydrogen or other reducing gas. The door of the vacuum chamber and the front are held vacuum-tight by ground surface contact held by sturdy spring clips. The central part of the door and the back of the chamber is constructed of a cast grid on which rests a mica plate made vacuum-tight with its frame — a construction which permits inspection of the contents of the vacuum chamber by means of an electric lamp at the back of the oven beyond the vacuum chamber. The oven proper is provided with two perforated aluminum shelves and is equipped with cast aluminum racks allowing the shelves to be placed at any height desired, when the vacuum chamber is removed.

With cord and plug and high-grade thermometer on which graduations are etched to 200° C. When ordering, specify voltage..... **$295.50**

5309 ——, similar to above, but **12×12×28 inches,** with cast bronze vacuum chamber, inside measurements, 9 inches diameter by 18 inches deep, properly supported and provided with connections for vacuum and passing of a current of hydrogen or other reducing gas. The body of the chamber is square, with rounded corners. It is provided with cast ribs on the side to accommodate up to ten shelves — six shelves only supplied.

With cord and plug and high-grade thermometer on which graduations are etched to 200° C. When ordering, specify voltage..... **416.50**

FREAS' ELECTRIC CONDITIONING OVENS for the determination of moisture in textile materials, paper, etc., also for chemical work when it is desirable to weigh the dried samples without exposure to the exterior atmosphere. **Description and prices on application.**

DRYING PAPER. See **No. 6324.**

No. 5325

No. 5311

No. 5312

No. 5314

No. 5330

No. 5331

5311 **ELECTRIC IRON, 6-lb.,** for use on 120 volts direct current or alternating current. Consumption, 550 watts. With detachable plug and 6 feet of cord and reversible stand..... **$7.50**

5312 **ELECTRIC STOVE, PORTABLE, THREE-HEAT, 6 inches diameter,** for use on 110 volts direct current or alternating current. Consumption, 500 watts. For use with any flat-bottom vessel. With plug and cord..... **9.50**

5314 **ELECTRIC SOLDERING IRON, 12-ounce,** $\frac{5}{16} \times 12$ inches, for use on either direct current or alternating current circuits of 120 volts. Consumption, 75 watts. With cord and plug..... **9.75**

ELECTROLYSIS APPARATUS. See pages 190 and 191.

5325 **EUDIOMETERS, BUNSEN'S,** with platinum electrodes, graduated to 1/5 cc.

	a	b
Capacity, cc.....	50	100
Each.....	**$3.50**	**5.00**

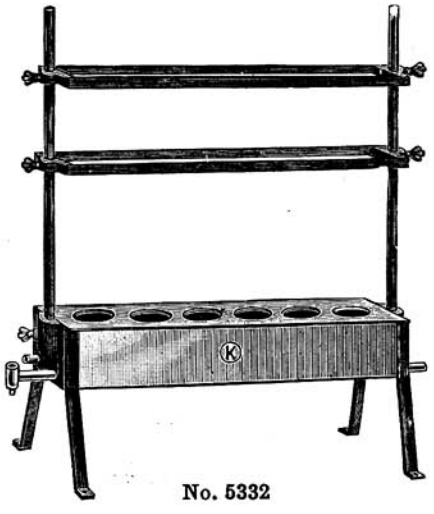
EVAPORATING DISHES. See **Dishes, Evaporating.**

3830 **EXPANDER, TUBE AND BULB,** for stretching necks of rubber bulbs and tubes..... **.75**

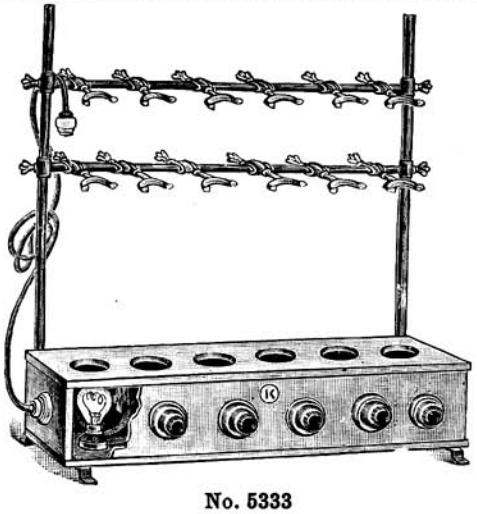
5330 **EXTRACTION APPARATUS, SOXHLET'S.** Complete with flask, extractor and condenser.

	a	b	c
Capacity, cc.....	70	100	200
Each.....	**$3.45**	**4.35**	**5.40**

5331 **——, with bulb condenser and ground joints** in place of cork stopper. Capacity 100 cc. Complete as illustrated..... **8.00**



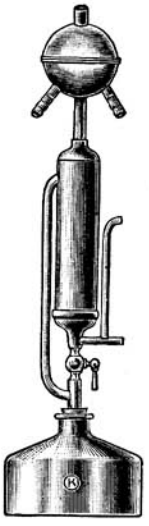
No. 5332



No. 5333

5332 **EXTRACTION APPARATUS HEATER,** 23 inches long, 4 inches deep, 4½ inches wide. Polished copper, tinned inside. Six holes, 2½ inches diameter; racks adjustable; extreme height, including rods, 31 inches..... **32.00**

5333 **EXTRACTION APPARATUS HEATER, ELECTRIC,** 30½ inches long, 5½ inches wide, height including legs, 7 inches. Constructed of fire-proof asbestos wood; six holes 1¾ inches diameter with electric lamp with switch beneath each opening. Extreme height, including rods, 31½ inches. Six sets of adjustable extension spring clamps for extractors and condensers. Complete as illustrated with cord and plug..... **72.50**



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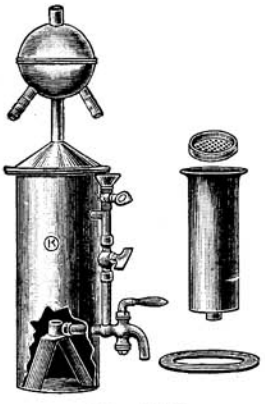


No. 5337

No. 5338

5335 **EXTRACTION APPARATUS, Teas,** as used in tanning laboratories. Extractor flask (1 quart capacity) and condenser of heavy copper **$33.00**

5337 **EXTRACTION APPARATUS, Reed's,** for bark and wood extracts, widely used in tanning laboratories. Polished copper. Complete with Soxhlet spherical condenser **50.00**

5338 **EXTRACTION APPARATUS, Underwriters' Laboratories Pattern,** for use with rubber compounds, etc. Complete with metallic spiral reflux condenser, " Pyrex " glass flask, and glass siphon tube, all of special dimensions recommended by the Joint Rubber Insulation Committee **3.75**

5338a **METALLIC SPIRAL REFLUX CONDENSER** as used in above **2.75**

5338b **SPECIAL GLASS SIPHON** as used in above ..... **.70**

5424 **RUBBER EXTRACTION FLASK,** 400 cc., as used in above ..... **.35**

5340 **EXTRACTION THIMBLES, WHATMAN'S FAT-FREE,** absolutely seamless; can be used repeatedly.

	a	b	c	d	e	f	g	h	i
Size, mm.	10×50	19×90	22×80	26×60	25×80	25×100	33×80	33×94	43×123
Box of 25	**$3.50**	**3.50**	**3.50**	**3.50**	**4.00**	**4.90**	**4.00**	**4.90**	**7.90**

EXTRACTION FLASKS. See **Flasks, Extraction.**

5342 **EXTRACTION THIMBLES, ALUNDUM.** (See index, **" Alundum Ware,"** for characteristics.) Alundum thimbles are preferable to paper thimbles in that they remain constant in weight and may be used an indefinite number of times and permit the ignition of the extracted residue without removing the residue from the thimble. Thickness of wall, about one mm.

Three degrees of porosity may be obtained — 36.9 per cent., 40.7 per cent. and 47.4 per cent. We carry in stock, however, only 40.7 per cent.

	a	b	c	d	e	f	g
Outside diameter, mm.	6	19	25	30	34	35	45
Height, mm.	32	90	70	80	100	55	127
Round bottom, each	**$0.28**				**1.00**		**1.10**
Flat bottom, each		**.65**	**.78**	**.84**		**.90**	

No. 5344

5344 **EXTRACTION TUBES, SOXHLET'S.**

	a	b	c
Capacity, cc.	70	100	200
Each	**$1.85**	**2.50**	**3.50**

5350 **FILE, ROUND, rat-tail,** good quality, 5 inches long **$0.18**

5351 **FILE, TRIANGULAR, glass cutting,** good quality, 5 inches long ..... **.16**

5355 **FILTER CONES, ALUNDUM,** for use with the ordinary 60 degree funnel to which it is held firmly by stretching a rubber gasket over the top of the funnel before introducing the cone. Light aluminum stands are supplied, without extra charge, with the cones for supporting them on the balance pan. Three degrees of porosity may be obtained — 36.9 per cent., 40.7 per cent. and 47.4 per cent. Our stock, however, contains filter cones 40.7 per cent. only.

	a	b	c	d
Diameter, inches	1¾	2½	3	4½
Height, inches	1 5/16	1⅞	2 7/16	3½
Capacity, cc.	20	50	60	100
Each	**$0.33**	**.65**	**.95**	**1.65**

5356A **RUBBER GASKETS** for use with above filter cones in making the proper connections with the funnels. For use with **No. 5355a** ..... **.06**

5356B ——, for use with **No. 5355b** ..... **.06**

5356C ——, for use with **No. 5355d** ..... **.11**

FILTER DISCS. See **Plates, Filter.**

FILTER PAPERS

HARCOURT FILTERS

for

Qualitative Work

These filters are made from a pure white paper of exceptional quality, of tough texture and very rapid. This grade of paper is suggested for general use in the laboratory and for all qualitative work.

5365 HARCOURT FILTERS, round, in boxes containing 100 filters.

	a	b	c	d	e	f
Diameter, inches	3	4	5	6	8	10
Per box	**$0.17**	**.21**	**.25**	**.34**	**.65**	**.75**

5366 ——, in sheets 19×19 inches.....Per quire **$0.75**

Per ream **12.00**

Arthur D. Little, Inc.

DOUBLE ACID WASHED ASHLESS FILTER PAPER

for

General Quantitative Work

This paper is an American product produced only after two years' careful experimentation and research by one of the leading consulting organizations of the country — a concern with 35 years' experience in the application of chemistry to industry. It is made by chemists for chemists in a building devoted exclusively to industrial chemistry.

It is a paper made for **General Quantitative Work** and its combination of properties permits the elimination of many of the special purpose papers formerly required. It is superior to any American or foreign made paper for all-round laboratory work.

This paper is " ashless " — it is **washed with both hydrochloric and hydrofluoric acid** and is made in the only mill in the world operating on distilled water.

It **retains Barium Sulphate** and precipitates of equal fineness, but its close texture does not sacrifice speed of filtration. It is faster than any paper on the market with equal retention of filtrate and may be used for commercial work where time is important. This paper is stronger than any rapid quantitative filter on the market. Its great strength permits its use for ordinary Buchner funnel work and, except for " crude fiber " analyses, eliminates the necessity for a specially treated paper for this purpose.

It is subjected to a system of rigid inspection and test that insures a high degree of uniformity. Each filter is inspected before a bright light before it is packed so that every circle can be used without hesitation.

Cat. No. 5368	**a**	**b**	**c**	**d**	**e**	**f**	**g**
Diameter of Circle, cms.	5.5	7	9	11	12.5	15	18.5
Ash Content Per Circle, gram	.000015	.000024	.00004	.00006	.00008	.00011	.00017
Per Sealed Box, 100 Circles	**$1.10**	**1.20**	**1.70**	**2.00**	**2.30**	**2.70**	**3.60**

WHATMAN FILTER PAPER

for

Qualitative and Quantitative Work

Messrs. W. & R. Balston of Springfield Mill, Maidstone, England, manufacturers of the well-known, widely used, genuine hand-made Whatman Drawing Papers, are producing a range of filter papers the remarkable merits of which have made them the standard of excellence. The applications mentioned in the following listings will convey to the chemist the grade best suited to his requirements.

All Whatman Filters are packed in cardboard boxes sealed with a band and distinctly labeled. Each box contains 100 filters.

5370 FILTER PAPER, Whatman No. 1, round, a high-grade rapid filter paper for general qualitative work when the weight of the ash is of no consequence. It is widely used in the determination of phosphorous for the filtration of the yellow ammonium-phospho-molybdate precipitate when obtained by long digestion. It is a popular grade for general work in sugar laboratories.

	a	b	c	d	e	f	g
Ash per Circle, gram	.00017	.00028	.00046	.00076	.0011	.0016	.0021
Diameter, cms.	4.25	5.5	7	9	11	12.5	15
Per Box	**$0.18**	**.19**	**.22**	**.27**	**.32**	**.42**	**.56**
	h	i	j	k	l	m	n
Ash per Circle, gram	.0032	.0054	.0068	.0096	.0138	.0150	.0233
Diameter, cms.	18.5	24	27	32	38.5	40	50
Per Box	**$0.78**	**1.40**	**1.64**	**2.56**	**3.06**	**3.48**	**4.88**

5370A ——, in sheets, 18¼×22½ inches.....Per hundred **4.95**

5371 ——, Whatman No. 2, round, a stout paper which filters rapidly. Especially suited for use in the qualitative analysis of the alkaline earths. Used extensively in fertilizer, cement, steel and ore mining laboratories.

	a	b	c	d	e	f	g
Ash per Circle, gram	.00028	.0004	.0007	.0012	.0018	.0024	.0034
Diameter, cms.	4.25	5.5	7	9	11	12.5	15
Per Box	**$0.22**	**.23**	**.30**	**.38**	**.47**	**.58**	**.82**
	h	i	j	k	l	m	n
Ash per Circle, gram	.0052	.0089	.0113	.0158	.0229	.0247	.0387
Diameter, cms.	18.5	24	27	32	38.5	40	50
Per Box	**$1.16**	**1.98**	**2.40**	**3.66**	**4.45**	**5.05**	**6.65**

5372 ——, Whatman No. 3, round, a very stout filter paper for general qualitative work. Slightly slower than **Nos. 1** and **2,** but very retentive. Will withstand considerable washing. Especially adapted for filtering such fine precipitates as metastannic acid, properly precipitated calcium oxalate, ammonium-phospho-molybdate when rapidly precipitated by mechanical shaker as in iron and steel laboratories, etc. Very satisfactory for filtering the solution of a fusion made with Eschka's mixture in determining sulphur in coal and coke. Valuable for use in the recovery of small quantities of silver from solution, giving an excellent separation if not too great an excess of the chloride precipitating salt is present.

	a	b	c	d	e	f	g
Diameter, cms.	5.5	7	9	11	12.5	15	18.5
Per Box	**$0.38**	**.45**	**.55**	**.63**	**.81**	**1.16**	**1.64**
	h	i	j	k	l	m	
Diameter, cms.	24	27	32	38.5	40	50	
Per Box	**$2.81**	**3.44**	**5.23**	**6.33**	**7.22**	**9.55**	

5373 ——, Whatman No. 4, round, a soft paper of open texture. Extremely rapid but not recommended for use with the finest precipitates. For the very rapid and perfect filtration of gelatinous and large-particle precipitates such as ferric hydroxide, aluminum hydroxide, etc. Excellent for filtering fruit juices, syrups, oils, etc. Very popular in copper and other ore mining, sugar and cement laboratories.

	a	b	c	d	e	f	g
Diameter, cms.	5.5	7	9	11	12.5	15	18.5
Per Box	**$0.30**	**.33**	**.45**	**.55**	**.72**	**1.00**	**1.44**
	h	i	j	k	l	m	
Diameter, cms.	24	27	32	38.5	40	50	
Per Box	**$2.46**	**3.00**	**4.55**	**5.50**	**6.33**	**8.33**	

5373A ——, in sheets 18¼×22½ inches.....Per hundred **9.70**

5374 ——, Whatman No. 5, round, a very tough, hard paper, close in texture, that will retain the finest precipitates, such as barium sulphate and lead sulphate, even when freshly precipitated. Particularly adapted for use with solutions that are filtered with difficulty; slow filtering with cold solutions, but surprisingly rapid with hot solutions considering its retentiveness. Suitable for vacuum filtrations with Buchner funnel, etc.

	a	b	c	d	e	f	g
Diameter, cms.	5.5	7	9	11	12.5	15	18.5
Per Box	**$0.22**	**.30**	**.38**	**.45**	**.60**	**.83**	**1.23**
	h	i	j	k	l	m	
Diameter, cms.	24	27	32	38.5	40	50	
Per Box	**$1.98**	**2.41**	**3.72**	**4.45**	**5.11**	**6.65**	

5374A ——, in sheets, 18¼×22½ inches.....Per hundred **7.72**

Continued on Following Page

WHATMAN FILTERS

Continued from Preceding Page

5375 **FILTER PAPER, Whatman No. 30,** round, a single-acid-washed rapid and retentive paper of low ash content. For the filtration of ammonium-phospho-molybdate precipitate, properly precipitated barium sulphate, in volumetric lime determinations, and for general quantitative work when the lowest ash is not important. Very popular in cement and metallurgical laboratories.

	b	c	d	e	f	g	h
Ash per Circle, gram	.000077	.00012	.0002	.0003	.0004	.00057	.00087
Diameter, cms.	5.5	7	9	11	12.5	15	18.5
Per Box	**$0.60**	**.75**	**1.00**	**1.35**	**1.65**	**2.11**	**3.00**

5376 ——, **Whatman No. 31,** round, a single-acid-washed paper, similar to **No. 30,** but more open in texture, making it a very rapid filter. For the very rapid filtration of gelatinous and large-particle precipitates, volumetric determinations of phosphates, also for determining silicon, etc., in iron analysis, etc., when the lowest ash is not of importance. A very popular grade in metallurgical laboratories.

	a	b	c	d	e	f	g
Ash per Circle, gram	.000077	.00012	.0002	.0003	.0004	.00057	.00087
Diameter, cms.	5.5	7	9	11	12.5	15	18.5
Per Box	**$0.60**	**.75**	**1.00**	**1.35**	**1.65**	**2.11**	**3.00**

5377 ——, **Whatman No. 40** ("Ashless"), round, standard double-acid-washed for analytical purposes having been subjected to the treatment of hydrochloric and hydrofluoric acids, which extract all traces of silicious matter. Very low ash. Filters rapidly and retains fine precipitates. For general gravimetric quantitative work. Especially recommended for crystalline precipitates such as magnesium-ammonium-sulphate, etc.

	a	b	c	d	e	f	g
Ash per Circle, gram	.00003	.00005	.000082	.00012	.00016	.00023	.00035
Diameter, cms.	5.5	7	9	11	12.5	15	18.5
Per Box	**$1.22**	**1.35**	**1.89**	**2.25**	**2.56**	**3.00**	**4.02**

5378 ——, **Whatman No. 41** ("Ashless"), round, double-acid-washed, but more open in texture, therefore filtering more rapidly than **No. 40.** For rapid quantitative work with such precipitates as do not readily pass through the paper. Widely used in determining silicon in iron and steel analysis.

	a	b	c	d	e	f
Ash per Circle, gram	.00003	.00005	.000082	.00012	.00016	.00023
Diameter, cms.	5.5	7	9	11	12.5	15
Per Box	**$1.22**	**1.35**	**1.89**	**2.25**	**2.56**	**3.00**

5379 ——, **Whatman No. 42** ("Ashless"), round, double-acid-washed, similar in its chemical qualities to **Nos. 40** and **41,** but differing in physical properties, being much harder and extremely close in texture. Adapted especially for the finest precipitates that ordinarily are filtered with difficulty, and for such precipitates as barium sulphate, etc., when circumstances do not allow them to be precipitated in hot solution.

	a	b	c	d	e	f
Ash per Circle, gram	.00003	.00005	.000082	.00012	.00016	.00023
Diameter, cms.	5.5	7	9	11	12.5	15
Per Box	**$1.22**	**1.35**	**1.89**	**2.25**	**2.56**	**3.00**

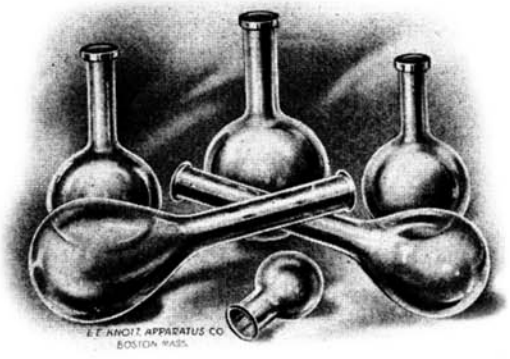
5380 ——, **Whatman No. 44** ("Ashless") round, double-acid-washed, of thinner substance than **No. 40,** and of lower ash content. This paper is recommended for use when the greatest possible degree of accuracy in quantitative work is required.

	a	b	c	d	e	f
Ash per Circle, gram	.00002	.00003	.00005	.000077	.0001	.00014
Diameter, cms.	5.5	7	9	11	12.5	15
Per Box	**$1.49**	**1.65**	**2.25**	**2.83**	**3.11**	**3.99**

5381 ——, **Whatman No. 50** (hardened), round, specially hardened by treatment with nitric acid. Very tough. Will resist great pressure and retain the very finest precipitates. Can be used repeatedly, the hard, smooth surface admitting of precipitates being scraped or washed off without injury to the paper. Especially adapted for use with vacuum. As substitutes for platinum cones and for use as supports in large folded filters to prevent them bursting at the points, the small sizes of **No. 50** up to 7 cms. are very useful.

	a	b	c	d	e	f	g
Diameter, cms.	4.25	5.5	7	9	11	12.5	15
Per Box	**$0.61**	**1.00**	**1.33**	**1.89**	**2.22**	**2.56**	**3.00**

FILTER PLATES. See page 281.



5405 FLASKS, FLAT BOTTOM.

	a	b	c	d	e	f	g	h
Capacity, cc.	30	60	120	250	500	1000	2000	4000
Each.	**$0.12**	**.14**	**.15**	**.18**	**.24**	**.34**	**.50**	**1.25**

5407 FLASKS, FLAT BOTTOM, "PYREX" (See index, **"Pyrex" Glassware,** for characteristics.)

	a	b	c	d	e	f	g	h	i	j	k	l
Capacity, cc.	50	100	150	200	300	400	500	700	1000	1500	2000	3000
Takes Stopper No. . . .	K13	K15	K17	K21	K23	K23	K25	K25	K28	K33	K37	K37
Each.	**$0.19**	**.20**	**.22**	**.24**	**.28**	**.30**	**.33**	**.40**	**.48**	**.56**	**.65**	**.84**

5408 FLASKS, RING NECK, FLAT BOTTOM, "PYREX" GLASS.

	a	b	c	d
Capacity, cc.	500	700	1000	2000
Takes Stopper No.	K23	K25	K30	K33
Each.	**$0.42**	**.52**	**.60**	**.86**

5409 FLASKS, FLAT BOTTOM, "FUSED SILICA." Bulb transparent, neck glazed. Spherical shape.

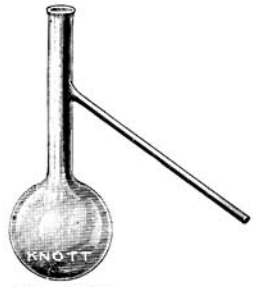
	a	b	c	d	e	f	g
Capacity, cc.	50	100	150	200	250	500	1000
Each.	**$4.78**	**6.27**	**7.27**	**8.33**	**9.38**	**14.61**	**25.00**

5411 FLASKS, ROUND BOTTOM, spherical.

	a	b	c	d
Capacity, cc.	120	250	500	1000
Each.	**$0.13**	**.15**	**.21**	**.34**

5413 FLASKS, ROUND BOTTOM, "FUSED SILICA." Bulb transparent, neck glazed.

	a	b	c	d	e	f	g
Capacity, cc.	50	100	150	200	250	500	1000
Each.	**$4.78**	**6.28**	**7.28**	**8.33**	**9.40**	**14.60**	**25.00**



No. 5415

5415 FLASKS, FRACTIONAL DISTILLATION, with side tubes.

	a	b	c	d	e	f
Capacity, cc.	15	30	125	250	500	1000
Each.	**$0.25**	**.33**	**.45**	**.55**	**.68**	**1.10**

5416 ——, "PYREX" GLASS. (See index, **"Pyrex" Glassware** for characteristics.)

	a	b	c	d	e	f
Capacity, cc.	100	200	250	500	1000	2000
Takes Rubber Stopper No. . .	K17	K19	K19	K21	K25	K37
Each.	**$0.50**	**.60**	**.65**	**.78**	**1.30**	**1.80**

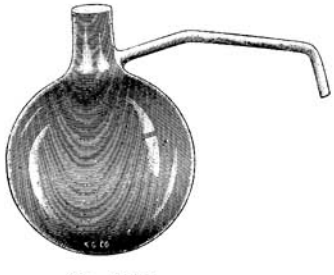
5417 FLASKS, DISTILLATION, "FUSED SILICA." Bulb transparent, neck and side arm glazed. Spherical with side arm.

	a	b	c	d
Capacity, cc.	50	100	150	200
Each.	**$6.90**	**8.35**	**9.40**	**10.45**

	e	f	g
Capacity, cc	250	500	1000
Each.	**$11.45**	**16.65**	**29.15**

5418 FLASKS, ENGLER'S DISTILLATION, "PYREX" GLASS. (See index, **"Pyrex" Glassware,** for characteristics.) For fractional distillation of creosote and petroleum. Made to standard dimensions according to the American Society for Testing Materials and the United States Bureau of Mines.

	a	b	c
Capacity, cc.	100	200	250
Each.	**$0.65**	**.74**	**.78**


No. 5418

No. 5435

No. 5437

5419 FLASKS, ERLENMEYER.

	a	b	c	d	e
Capacity, cc.	60	120	250	500	1000
Each	**$0.14**	**.16**	**.18**	**.24**	**.35**

5421 FLASKS, ERLENMEYER, "PYREX" GLASS. (See index, "Pyrex" Glassware, for characteristics.)

	a	b	c	d	e	f	g	h	i	j	k	l
Capacity, cc.	50	100	150	200	250	300	500	600	750	1000	1500	2000
Takes Stopper No.	K17	K19	K21	K23	K23	K25	K28	K28	K30	K33	K40	K40
Each	**$0.18**	**.20**	**.21**	**.22**	**.24**	**.28**	**.32**	**.34**	**.38**	**.46**	**.56**	**.65**

5423 FLASKS, ERLENMEYER, WIDE MOUTH, "PYREX" GLASS.

	a	b	c	d
Capacity, cc.	250	500	750	1000
Takes Stopper No.	K33	K47	K51	K51
Each	**$0.24**	**.32**	**.38**	**.46**

5424 FLASK, EXTRACTION, RUBBER, "PYREX" GLASS. (See index, "Pyrex" Glassware for characteristics.) Capacity 400 cc. Takes Rubber Stopper No. K37 ..... **$0.35**

5425 FLASKS, EXTRACTION, SOXHLET'S, large mouth.

	a	b	c	d	e
Capacity, cc.	50	100	250	500	1000
Each	**$0.15**	**.20**	**.28**	**.33**	**.60**

5427 FLASK, EXTRACTION, "PYREX." Round bottom, capacity 100 cc. Height 3⅞ inches, diameter 2⅜ inches, diameter of neck 1⅛ inches ..... **.22**

5429 ——, round bottom, capacity 2000 cc. Height 9$\frac{11}{16}$ inches, diameter 6$\frac{7}{16}$ inches, diameter of neck 2$\frac{23}{32}$ inches ..... **.78**

5430 FLASKS, FILTERING, conical form with side neck, heavy glass, uniform.

	a	b
Capacity, cc.	250	500
Each	**$0.50**	**.70**

5430A ——, **"PYREX" GLASS.** (See index, "Pyrex" Glassware for characteristics.)

	a	b	c	d	e
Capacity, cc.	250	500	1000	2000	4000
Takes Rubber Stopper No.	K25	K25	K30	K37	K37
Each	**$0.78**	**1.05**	**1.60**	**2.65**	**4.45**

5431 FLASK, KJELDAHL or DIGESTION, for nitrogen determinations. Capacity 200 cubic centimeters ..... **.28**

5433 FLASKS, KJELDAHL or DIGESTION, "PYREX." Round bottom, long neck.

	a	b	c
Capacity, cc.	300	500	800
Each	**$0.32**	**.41**	**.50**

No. 5434

5434 FLASK, VISCOSIMETER, "PYREX" GLASS. (See index, "Pyrex" Glassware for characteristics.) Capacity 60 cc. **$1.40**

5435 FLASKS, VOLUMETRIC, without glass stopper, graduated with one and two marks as follows:

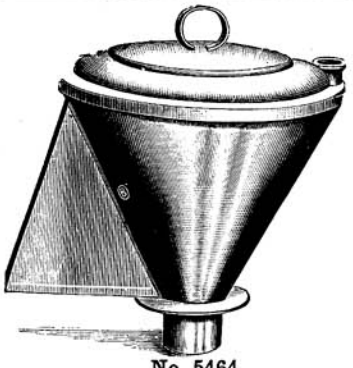
	a	b	c	d	e	f	g	h	i	j	k	l	m
Capacity, cc.	5	10	20	25	50	50 & 55	100	100 & 110	200	200 & 220	250	500	1000
Each	**$0.35**	**.40**	**.40**	**.45**	**.50**	**.55**	**.55**	**.60**	**.60**	**.75**	**.75**	**.80**	**1.25**

5437 FLASKS, VOLUMETRIC, with glass stopper, graduated as follows:

	a	b	c	d	e	f	g
Capacity, cc.	25	50	100	200	250	500	1000
Each	**$0.80**	**.85**	**1.05**	**1.10**	**1.20**	**1.35**	**1.60**

No. 5445

No. 5455a-b



No. 5464

No. 5466

No. 5468

No. 5450

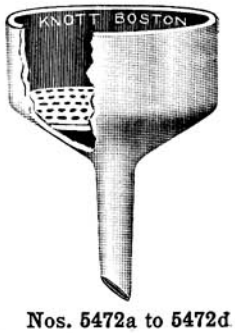
No. 5457

No. 5459

No. 5460

No. 5462

No. 5453



Nos. 5472a to 5472d

5-270 **FLUSH PLATE, nickel-plated,** for inserting in any table flush with the top surface. When fitted to a table and screwed into place, it offers an excellent socket for a support rod for funnel and filter rings, clamps, etc. Tapped ¼×20 for 10 mm. rods. (See illustration, page 9.) **$0.85**

5-272 ——, tapped ⅜×16 for 13 mm. rods. (See illustration, page 9.) **1.05**

5-274 ——, tapped ½×12 for 19 mm. rods. (See illustration, page 9.) **1.25**

5445 **FORCEPS, STEEL,** 5-inch, for handling phosphorus, potassium, etc. ..... **.17**

5450 **FUNNELS, BUNSEN'S,** stem cut at an angle of 60°.

	a	b	c	d	e	f	g	h
Diameter, inches.....	2	2½	3	4	5	6	8	10
Each.....	**$0.31**	**.32**	**.36**	**.45**	**.55**	**.78**	**1.08**	**1.80**

3865 **FUNNELS, BURETTE**.....Each **.20**

5452 **FUNNELS, GLASS, without stems,** for sugar analysis. Useful for various salts.

	a	b	c
Diameter, mm.....	70	90	100
Each.....	**$0.42**	**.46**	**.50**

5453 **FUNNELS, RIBBED GLASS,** for quick filtering.

	a	b	c
Diameter, inches.....	7¼	8¾	10¾
Each.....	**$1.45**	**1.80**	**1.95**

5455a **FUNNEL, SEPARATORY,** 60 degree, heavy glass, with stopcock. Diameter 6 inches..... **4.80**

5455b ——, diameter 10 inches..... **8.50**

5457 **FUNNELS, SEPARATORY, cylindrical.**

	a	b	c
Capacity, cc.....	30	60	125
Each.....	**$1.40**	**1.50**	**1.90**

5459 **FUNNELS, SEPARATORY, globe shape.**

	a	b	c	d	e
Capacity, cc.....	60	125	250	500	1000
Each.....	**$1.40**	**1.65**	**2.10**	**2.70**	**3.50**

5460 **FUNNELS, SEPARATORY, SQUIBB'S, pear shape,** with glass stopper.

	a	b	c
Capacity, cc.....	125	250	500
Each.....	**$2.00**	**2.25**	**3.25**

5462 **FUNNEL, GRADUATED, SEPARATORY, CYLINDRICAL.** Long stem, capacity 250 cc..... **4.00**

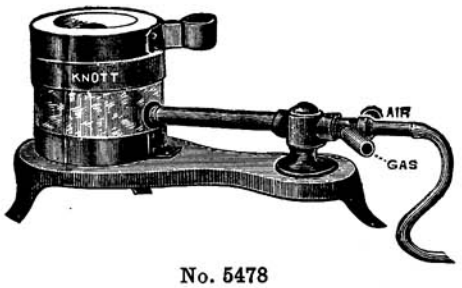
5464 **FUNNEL, POLISHED COPPER, DOUBLE WALL,** for **hot filtrations**..... **7.50**

5466 **FUNNEL, KOCH'S, POLISHED COPPER, single wall for hot filtrations.** With legs..... **5.50**

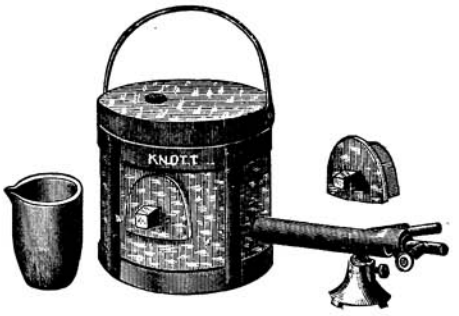
5468 ——, **double wall,** for **hot filtrations.** With legs..... **8.00**

5472 **FUNNELS, BUCHNER, PORCELAIN,** fixed perforated porcelain plates.

	a	b	c	d
Diameter, mm.....	82	102	138	200
Each.....	**$2.00**	**2.60**	**4.80**	**7.20**



No. 5478



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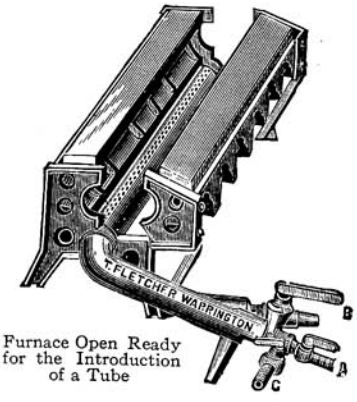
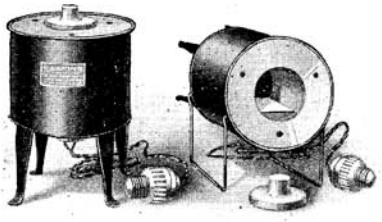


Furnace Open Ready for the Introduction of a Tube

No. 5480



Nos. 5482 and 5484

5478 **FURNACE, CRUCIBLE** with **Injector Gas Burner.** Operates with illuminating gas, natural gas or gasoline gas. Takes **No. 00** clay or lead crucibles. Clay parts, outside, measure 4⅛ inches × 5⅜ inches high. Pot inside, measures 2⅝ inches×2½ inches deep. Furnace on stand is 6½ inches high over all. Without foot blower, but complete with one **No. 00** clay crucible..... **$7.50**

5479 **FURNACE, CRUCIBLE AND MUFFLE.** Operates with illuminating gas, natural gas or gasoline gas. Takes muffle 3½×2⅞×6¼ inches and **No. 3** clay or lead crucible (3¾ inches diameter×4 inches high.) Pot and cover, outside, measures 9½ inches× 11 inches high; inside, 6½ inches deep ×6 inches diameter. Without blower, but complete with muffle and clay crucible **27.75**

5479A **PLUMBAGO MUFFLE,** 3½×2⅞×6¼ inches..... **3.00**

5480 **FURNACES, TUBE, for combustions.** Using the ordinary foot blower, this furnace will heat an iron tube ¾ to 1 inch in diameter, to its softening point in 10 minutes. Without the blast it will heat the same tube to redness. Can be used with natural gas, coal gas or gasoline gas.

	a	b	c
For tubes of length, inches.....	12	18	24
Each.....	**$24.50**	**30.00**	**34.50**

5482 **FURNACES, ELECTRIC, CRUCIBLE,** for work up to 1000° C. (1832° F.). Operates on 110 or 220 volt alternating current or direct current. The heating element of "Chromel" wire is wound on an alundum core, surrounded by a packing of special heat insulating material, enclosed in a sheet iron case. The maximum working capacity is 1000° C. (1832° F.) and by means of a controlling rheostat should be kept within this limit.

	a	b	c
Chamber, diameter, inches.....	2	4	5
Chamber, depth, inches.....	2½	4	5
Current comsumption, watts.....	370	1000	1200
Without controlling rheostat.....	**$31.10**	**61.10**	**94.45**

A wire stand for using furnace in horizontal position is furnished with **No. 5482a.**

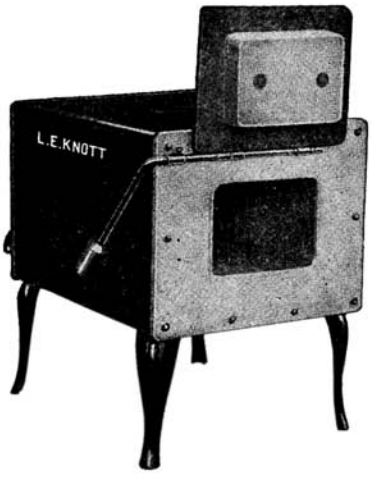
5484 **FURNACES, ELECTRIC CRUCIBLE,** same as above., but **with controlling rheostat.**

	a	b	c
Chamber, diameter, inches.....	2	4	5
Chamber, depth, inches.....	2½	4	5
Current consumption, watts.....	370	1000	1200
With controlling rheostat.....	**$44.45**	**78.85**	**112.25**

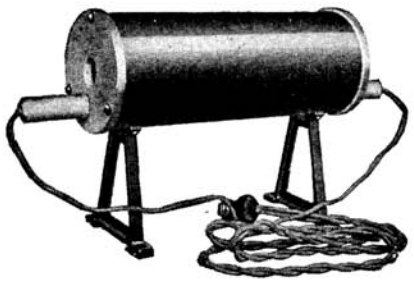
A wire stand for using furnace in horizontal position is furnished with **No. 5484a.**

REPAIR PARTS. PRICES ON APPLICATION

Fused Silica Combustion Tubing No. 6868m (22 mm. (⅞-inch) bore) **is recommended for all tube furnaces.**



Nos. 5494 and 5496



Nos. 5511 to 5513

5494 **FURNACES, ELECTRIC MUFFLE,** for work up to 1000° C. (1832° F.). Operates on 110 or 220 volts alternating current or direct current. The heating unit of " Chromel " wire is wound on an alundum muffle surrounded by a packing of special heat insulating material, enclosed in a sheet-iron case. The maximum working capacity is 1000° C. (1832° F.) and by means of a controlling rheostat, should be kept within this limit.

Without controlling rheostat.	**a**	**b**	**c**	**d**
Chamber, length, inches	7	10	12	14
Chamber, width, inches	3⅛	4¼	5¼	7½
Chamber, height, inches	2½	3	3¾	5¼
Current consumption, watts, full load	850	1300	2100	3400
Price, 110 or 220 volts, A. C. or D. C.	**$77.75**	**94.45**	**127.75**	**166.65**

NOTE.—When ordering, specify line voltage and whether alternating current or direct current.

5496 **FURNACES, ELECTRIC MUFFLE,** same as above, but **with** controlling rheostat.

	a	**b**	**c**	**d**
Chamber, length, inches	7	10	12	14
Chamber, width, inches	3⅛	4¼	5¼	7½
Chamber, height, inches	2½	3	3¾	5¼
Current consumption, watts	850	1300	2100	3400
Price, 110 or 220 volts, A. C. (60 cycle) or D. C.	**$93.35**	**112.25**	**151.00**	**205.50**

NOTE.—When ordering, specify line voltage, and whether alternating current or direct current.

REPAIR PARTS AND CHARGES

Immediate renewals can be made easily with the repair parts listed below.

5500 **ALUNDUM MUFFLE** for Furnace **Nos. 5494a** and **5496a** **$11.10**
5500A ——, wound ready for use **17.75**
5501 **ALUNDUM MUFFLE** for Furnace **Nos. 5494b** and **5496b** **16.65**
5501A ——, wound ready for use **27.20**
5502 **ALUNDUM MUFFLE** for Furnace **Nos. 5494c** and **5496c** **22.25**
5502A ——, wound ready for use **40.00**
5503 **ALUNDUM MUFFLE** for Furnace **Nos. 5494d** and **5496d** **33.35**
5503A ——, wound ready for use **58.90**
5504 **CHROMEL WIRE** for Furnace **Nos. 5494a** and **5496a** ..... Lot **6.65**
5505 ——, for Furnace **Nos. 5494b** and **5496b** ..... Lot **10.55**
5506 ——, for Furnace **Nos. 5494c** and **5496c** ..... Lot **17.75**
5507 ——, for Furnace **Nos. 5494d** and **5496d** ..... Lot **25.55**

5511 **FURNACE, ELECTRIC TUBE,** for work up to 1000° C. (1832° F.). Operates on 110 or 220 volts alternating current or direct current. The heating unit of " Chromel " wire is wound on an alundum tube, surrounded by a packing of special heat insulating material enclosed in a sheet iron case. The maximum working capacity is 1000° C. (1832° F.) and, by means of a controlling rheostat, should be kept within this limit. Current consumption 550 watts. **Without** controlling rheostat, chamber 1¼ inches diameter by 12 inches long. Current consumption 550 watts **33.35**

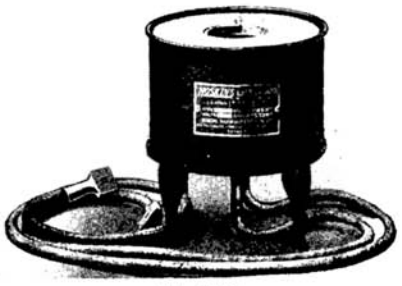
5513 **FURNACE,** same as **No. 5511,** but **with** controlling rheostat **46.65**

REPAIR PARTS AND CHARGES

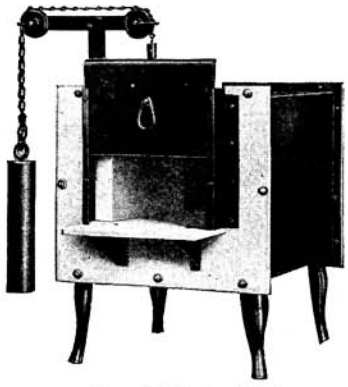
Immediate renewals can be made easily with the repair parts listed below.

5516 **ALUNDUM TUBE,** for Furnace **Nos. 5511** and **5513** **$6.65**
5516A ——, wound ready for use **11.10**
5518 **CHROMEL WIRE** for Furnace **Nos. 5511** and **5513** ..... Lot **4.45**

Fused Silica Combustion Tubing No. 6868m (22 mm. (⅞ inch) bore) **is recommended for all tube furnaces.**



No. 5521



Nos. 5530 to 5537

FURNACES, ELECTRIC CRUCIBLE, for work requiring temperatures up to 1100° C. (2000° F.) for use on alternating current only. These furnaces operate on low voltages (10 to 57 volts) and as regularly supplied for 110, 220 or 440 volts (60 cycles) circuit, require a transformer and controlling rheostat.

		b	c
	Diameter, chamber, inches	2	4
	Depth, chamber, inches	2½	6
	Current consumption, watts	1000	2000
5521	**Furnace,** only	**$33.35**	**$83.35**
5522	**Transformer**	**38.85**	**61.10**
5523	**Controlling Rheostat**	**17.75**	**23.35**
5524	**Complete Equipment,** for 110, 220 or 440 volts (60 cycles) A. C.	**89.95**	**167.80**

EXTRA HEATING UNITS

When not heated above 1100° C. (2000° F.), the life of a heating unit should be at least 1000 hours.

5526	——, for Furnace **No. 5521b**	**$6.15**
5527	——, for Furnace **No. 5521c**	**13.35**

FURNACE, ELECTRIC MUFFLE, for work up to 1100° C. (2000° F.) for use on alternating current only. The heating unit is in the shape of heavy hairpins which are distributed around the top, bottom and sides of a refractory muffle. Surrounding the heating units is a layer of special fire-brick heat insulation and outside of this, a sheet iron case. This furnace operates on low voltage and as regularly supplied, for 110, 220 or 440 volts (60 cycles) alternating current circuits, requires a transformer and a controlling rheostat. Chamber 4¼ inches wide, 3 inches high, 9 inches long. Current consumption 2750 watts.

5530A	**Furnace,** only	**122.25**
5530B	**Transformer**	**72.25**
5530C	**Controlling Rheostat**	**23.35**
5530D	**Complete Equipment,** furnace with transformer and controlling rheostat	**217.85**

FURNACE, ELECTRIC MUFFLE, same as **No. 5530,** but designed so that temperature regulation is secured by regulating transformer. Does not require a controlling rheostat. Chamber 7⅜ inches wide, 5 inches high, 12½ inches long. Current consumption, 6000 watts.

5533A	**Furnace,** only	**173.35**
5533B	**Regulating Transformer**	**216.65**
5533C	**Complete Equipment,** furnace with regulating transformer	**390.00**

FURNACE, ELECTRIC MUFFLE, same as **No. 5533,** but chamber 12 inches wide, 8 inches high, 19 inches long. Mounted on an angle iron stand which brings the shelf 40 inches above the floor. Current consumption 12,500 watts.

5535A	**Furnace,** only	**383.35**
5535B	**Regulating Transformer**	**316.65**
5535C	**Complete Equipment,** furnace with regulating transformer	**700.00**

FURNACE, ELECTRIC MUFFLE, same as **No. 5535,** but chamber 12 inches wide, 8 inches high, 26 inches long. Current consumption 15,000 watts. Does not require a controlling rheostat.

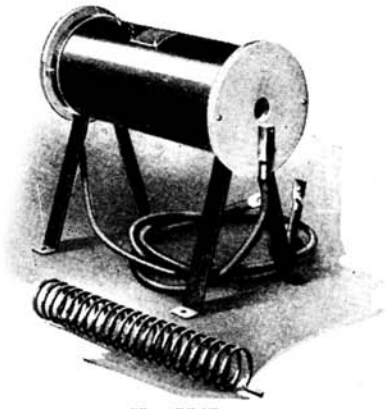
5537A	**Furnace,** only	**455.55**
5537B	**Regulating Transformer**	**361.00**
5537C	**Complete Equipment,** furnace with regulating transformer	**816.55**

Note.— **When ordering any of the above furnaces, specify line voltage.**

EXTRA HEATING ELEMENTS

When not heated above 1100° C. (2000° F.) the life of a heating unit should be at least 1000 hours.

5540	**EXTRA HEATING UNITS for Furnace No. 5530A** (10 per set)	Each unit	**$1.65**
5541	——, **for Furnace No. 5533A** (10 per set)	Each unit	**3.85**
5542	——, **for Furnace No. 5535A** (14 per set)	Each unit	**5.55**
5543	——, **for Furnace No. 5537A** (14 per set)	Each unit	**7.75**



No. 5547

FURNACE, ELECTRIC TUBE, for work up to 1100° C (2000° F.) for use on alternating circuits only, 110,220 or 440 volts (60 cycles) alternating current. The heating unit is of "Chromel" wire, in the form of a coil which radiates heat directly on the contents of the furnace. Surrounding the heat unit is a layer of special fire-brick heat insulation, and outside of this, a sheet iron case. The temperature regulation is by means of a controlling rheostat. Diameter of chamber 1¼ inches, length 12 inches. Current consumption 1000 watts.

5547A **Furnace,** only **$38.85**

5547B **Transformer** **33.35**

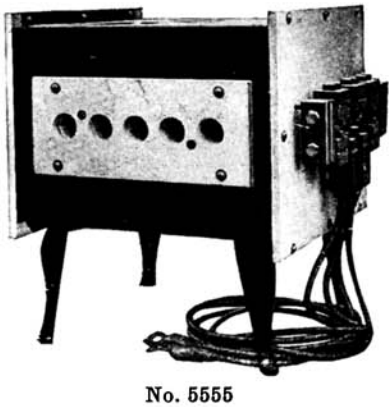
5547C **Controlling Rheostat** **15.55**

5547D **Complete Equipment,** furnace with controlling rheostat and transformer **87.75**

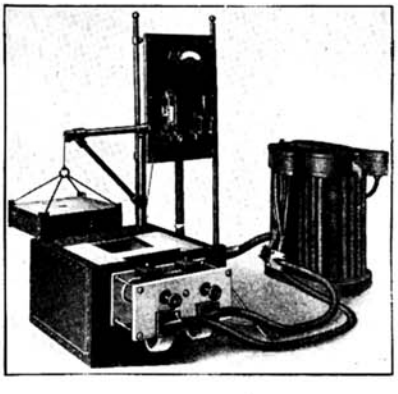
REPAIR PARTS

When not heated above 1100° C. (2000° F.) the life of the heating unit should be at least 1000 hours. By having at hand extra heating units, immediate repairs can be made by the operator.

5551 **EXTRA HEATING COIL** for Furnace **No. 5547A** **5.55**



No. 5555



Nos, 5556B to 5559B

5555 **FURNACE, ELECTRIC, MULTIPLE COMBUSTION TUBE,** for work up to 1100° C. (2000° F.) for use on alternating currents, 110, 220, or 440 volt, 60-cycle lines. The combustion tubes are heated by direct radiations from "hairpin" heating units between which the tubes lie. Temperature regulation is accomplished by means of a regulating transformer. With this furnace, five carbon combustions can be run simultaneously and will be found of great convenience and economy where a large number of carbon determinations are to be made. Complete with transformer **372.50**

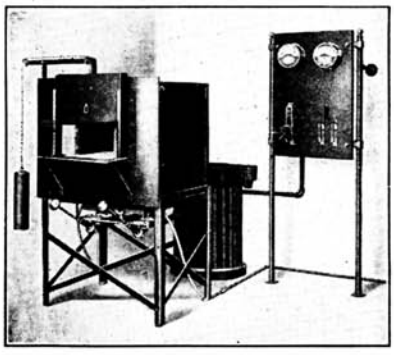
5555A **EXTRA HEATING UNITS** for above (8 per set) ..... Each unit **3.85**

FURNACE, ELECTRIC CRUCIBLE, for use on work requiring temperatures up to 1800° C. (3300° F.). Adapts itself to melting point determinations and may be used for melting metals up to 50 lbs. weight. Heating chamber is in a vertical position. Carbon which serves as the heating element is in the form of plates and these are arranged around the two opposite sides of the heating chamber. Temperature regulation is accomplished by adjusting carbon plates upon each other by means of two hand screws as shown in the illustration. Furnished for 110, 220 or 440 volts and 60 cycle circuits. Auxiliary equipment consists of a transformer and switchboard upon which are mounted a switch, circuit breaker and ammeter.

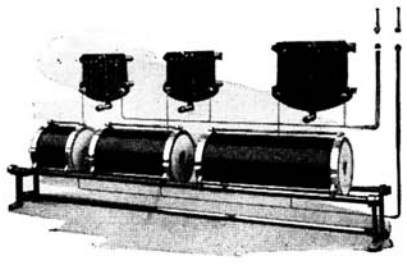
Chamber Dimensions			Current Consumption	Furnace Only		Complete Equipment 110 volts, 60 cycles	
Width	Length	Depth	at Full Load	Cat. No.	Price	Cat. No.	Price
4 inches	4 inches	4½ inches	12.5 K.W.	**5556A**	**$416.65**	**5556B**	**$776.65**
6 inches	6 inches	6½ inches	20.0 K.W.	**5557A**	**555.50**	**5557B**	**1034.45**
10 inches	10 inches	10½ inches	45.0 K.W.	**5559A**	**888.85**	**5559B**	**1767.75**

Prices on application for windings other than 110 volts.

Fused Silica Combustion Tubing No. 6868m (22 mm., (⅞ inch) bore) **is recommended for all Tube Furnaces.**



Nos. 5561B and 5562B



No. 5563

FURNACES, ELECTRIC MUFFLE, for use on work requiring temperatures up to 1400° C. (2500° F.). Minimum temperature, 1000° F. This furnace is especially adapted for heat-treating high-speed and carbon tool steels.

Auxiliary equipment consists of a transformer and switchboard equipped with line switch, circuit breaker, ammeter and a pyrometer with three feet thermo-couple.

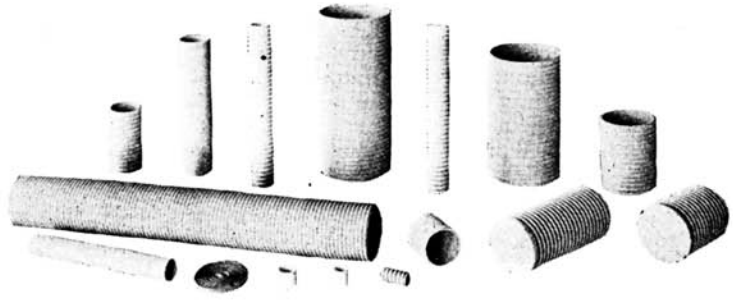
Chamber Dimensions			Current Consumption	Furnace Only		Complete Equipment 100 volts, 60 cycles	
Width	Height	Length	at Full Load	Cat. No.	Price	Cat. No.	Price
6½ inches	5 inches	12 inches	15.0 K.W.	**5561A**	**$444.45**	**5561B**	**$917.75**
12 inches	8 inches	18 inches	30.0 K.W.	**5562A**	**611.10**	**5562B**	**1341.10**

Prices on application for windings other than 110 volts

5563 FURNACE, ORGANIC COMBUSTION, 4, 8 and 12-inch sections, for 1¼-inch diameter tube, for work up to 1000° C. (1830° F.). Operates on 110 volts direct current or alternating current. Lateral adjustment for each furnace about 11½ inches; length of combustion tube required, 48 inches. Complete as illustrated with rheostats **180.00**

Organic Combustion Furnaces are built on order only. Sections of different lengths, voltages of 220 or 440 direct current or alternating current, and for tubes up to 3 inches diameter, can be obtained.

Prices Upon Receipt of Detailed Specifications

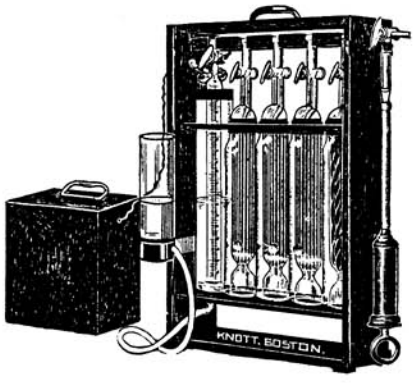


5565 FURNACE CORES, ELECTRIC, ALUNDUM. Alundum refractory cores have high heat conductivity and do not become electrical conductors when at the highest temperature obtained in the furnace. The wires should be protected by embedding them in alundum cement. Thus fully protected, they do not corrode under the most severe conditions since the alundum mixtures are chemically inert.

	a	b	c	d	e	f	g	h	i	j	k
Bore, inches	1	1⅛	2	2 1/16	2 1/16	2 1/16	3	3	3½	5	5
Length, inches	10	12	10	2 5/16	2 7/16	5	6¾	24	5	8¾	12
Pitch, inch	1/9	5/16	1/9	5/16	5/16	5/16	5/16	¼	5/16	5/16	⅓
Both Ends Open	**$5.28**	**5.84**	**6.10**		**2.20**	**2.50**		**13.33**	**5.55**		**9.50**
One End Closed				**$2.50**			**6.10**			**8.35**	

GAS ANALYSIS APPARATUS

No. 5575



No. 5577

5575 TRIPLE ORSAT GAS ANALYZER for CO_2, O_2 and CO, especially in flue and furnace gases.

This design is equipped with a master valve control whereby one valve controls all gas passages. The special valve seat has been so perfected that there is no metal-to-metal wear and leakage is absolutely prevented. Turning the indicating dial to the indicated point, opens communication between the burette and the desired container, gas inlet, vent, etc., with absolute precision. Metal vent tubes with shut-off valves are a feature that does away with rubber tubes and glass plugs found on other Orsats.

The levelling bottle always remains in vertical position, making it unnecessary to empty the water each time. Arrangements are provided whereby this Orsat automatically levels at zero without removing the levelling bottle.

Carrying case is well made and neatly finished. The inside is enamelled white. Complete directions and a list of duplicate repair parts (individually numbered) are attached to the inside of the case. Case, 3×12×14 inches. **$57.50**

5576 SINGLE ORSAT GAS ANALYZER for CO_2 only. This apparatus has same exclusive features as **No. 5575,** but has but one absorption pipette and is used for determining CO_2 only. Case, 3×8×14 inches. **45.00**

5577 WILLIAMS MODEL "A" ORSAT APPARATUS for the Complete Analysis of a Combustible Gas, containing carbon dioxide, illuminants, oxygen, carbon monoxide, hydrogen, methane and nitrogen.

Extensively used as the best of the modifications of the original Orsat, by reason of its many advantages of accuracy, speed, ease of adjustment and manipulation. The special form of bubbling pipette increases the rapidity of absorption. All parts easily cleaned.

Complete with directions, in finest quartered oak case, 12×4×17½ inches, rubbed finish, with inside exposed portions rubber-covered. Without explosion coil. **75.00**

5578 WILLIAMS MODEL "B" ORSAT APPARATUS for Analysis of CO_2, O_2 and CO, especially designed for analysis of flue gases.

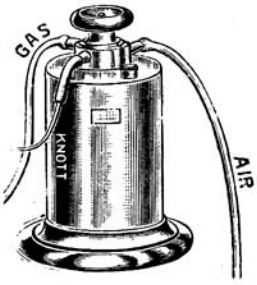
Complete with directions, in quartered oak case, 9½×4×17½ inches, rubbed finish, with inside exposed portions rubber-covered. **50.00**

5579 PORTABLE EXPLOSION COIL with batteries, in quartered oak case, same finish as above. **12.00**

No. 5590A

No. 5605

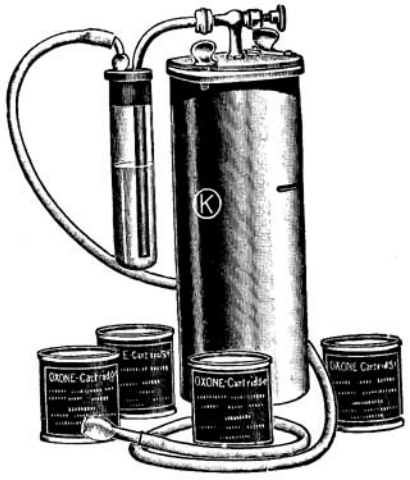
No. 5611



No. 5610

No. 5597

No. 5590B



No. 5612

5590 GAS APPARATUS for **sulphur determinations,** according to Mr. C. D. Jenkins, Massachusetts State Inspector of Gas and Meters..... **$19.75**

5590A GAS SAMPLE TUBES, according to Mr. C. D. Jenkins..... **1.45**

5590B GAS AMMONIA BULBS, according to Mr. C. D. Jenkins..... **1.45**

5596 GAS BOTTLE GENERATOR, capacity 8 ounces, complete with fittings..... **.65**

5597 ——, **capacity 16 ounces,** complete with fittings..... **.75**

5605 GAS COLLECTOR (**Beehive Shelf**) **of unglazed porcelain,** 2¾ inches high, for use in a sink or dish as the bottle rest for collecting gases over water..... **.45**

5607 GAS COLLECTOR (**Packard's Glazed Porcelain Beehive Shelf**). This collector is provided with a recessed top for holding the neck of the bottle, and since it is but one inch high, requires very little water, thus permitting the use of a shallow dish. Excellent for lecture desk..... **.30**

5610 GAS GENERATOR, GASOLINE, constructed wholly of brass, polished and nickeled. Height 7 inches, diameter 4½ inches. Interior contains 14 lineal feet of evaporating surface. Turret valve at top controls both gas and air outlets, also controls the size of the blowpipe flame. Built absolutely proof against any danger of flashing back of the flame. An air check is attached at the end of the filler tube to prevent over filling. Without rubber tubing..... **15.55**

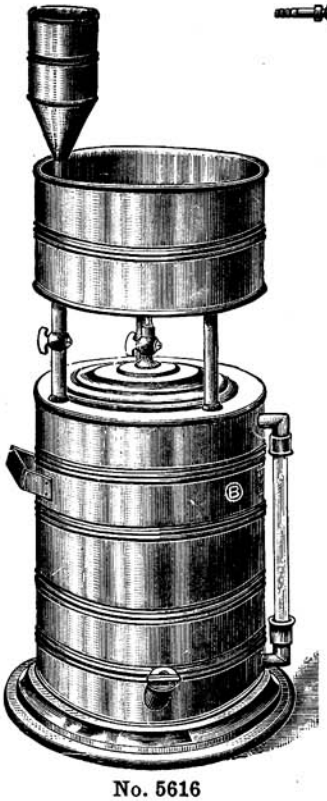
5611 GAS GENERATOR, KIPP'S, 500 cubic centimeters (pint) capacity..... **10.00**

5611A —— **1000 cubic centimeters (quart) capacity**..... **12.50**

5612 GAS GENERATOR, OXYGEN, of polished metal, 9½ inches high, weighing but 2½ pounds. Capacity at one charge 27 liters — nearly one cubic foot. The charge consists of an "Oxone Cartridge," a hermetically sealed tin which is to be punctured on top and bottom.
Produces **pure** oxygen instantaneously. This oxygen is at low pressure and as it leaves the generator is 99.3 per cent. pure. As it leaves the wash bottle it is considered 100 per cent. pure oxygen.
Simple and easy to handle, quickly recharged and always a source for obtaining pure oxygen instantly.
Complete outfit is packed in a finished portable case and comprises the generator with wash bottle, awl for perforating the tin, four oxone cartridges and rubber tubing lead..... **27.75**
NOTE.— The above outfit, using "Hydrone" in place of "Oxone," may be used to generate **pure hydrogen.**

5613 "**OXONE,**" sold only in two-pound tins.....Per tin **2.50**

5614 "**HYDRONE,**" sold only in two-pound tins.....Per tin **4.00**

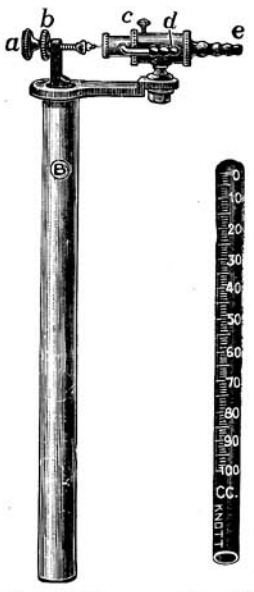


No. 5616

No. 5625

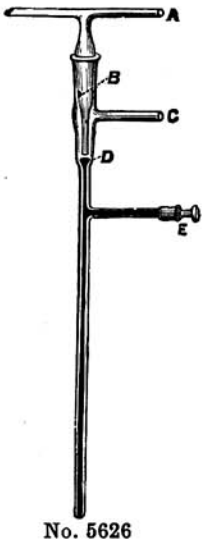
No. 5640

No. 5642

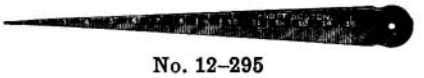


Nos. 5628 and 5629

No. 5620



No. 5626



No. 12–295

5616 **GAS HOLDER, Gasometer,** Berzelius' and Pepy's, improved form of heavy copper. Capacity, 5 gallons **$38.50**

5617 ——, **capacity 10 gallons** **49.00**

5620 **GAS MEASURING TUBES** for collecting gases over mercury.

	a	b
Capacity, cc.	50×1/5	100×½
Each	**$1.25**	**2.00**

5625 **GAS PRESSURE REGULATOR, Murrill's Improved,** for use with a thermostat. A constant temperature can be maintained regardless of the pressure variations in the gas supply. With two outlets as illustrated **16.50**

5626 **GAS REGULATOR, Reichert's,** adapted for water baths, drying ovens, incubators, sterilizers, etc. Secures constant temperature at any desired point from 1° C. up to the boiling point of mercury. **5.00**

5628 **GAS REGULATOR, Roux Bi-Metallic,** an accurate gas regulator, simple in construction, easily operated and adjusted to regulate an even temperature more constantly than any other thermo-regulator. Not liable to leak as it is made entirely of metal. Particularly well adapted for ovens and sterilizers. Length 10 inches. Complete with directions **13.25**

5629 ——, same as above, but **for high temperatures** **19.50**

12–295 **GAUGE, POLISHED STEEL, INSIDE TAPER,** for inside measure of tubes, holes, etc. Made of hardened polished steel and about 18 cms. long. Will measure from 1/10 to 15 mm **1.25**

5632 **GAUZE, ASBESTOS CENTER,** tinned iron wire, 5×5 inches with asbestos compressed in the mesh. Excellent for slow evaporations ..... Each **.16**

5634 **GAUZE, COPPER,** thick wire, mesh selected for use in heating chemical ware.

	a	b	c
Size, inches	4×4	6×6	Sq. Ft.
Each	**$0.12**	**.22**	**.85**

5635 **GAUZE, COPPER,** 80 mesh, 4×4 inches ..... **.30**

5637 **GAUZE, IRON,** thick wire, mesh selected for use in heating chemical ware.

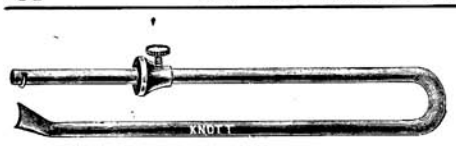
	a	b	c
Size, inches	4×4	6×6	Sq. Ft.
Each	**$0.05**	**.10**	**.35**

5640 **GERMINATING BOX, Ganong pattern** **1.50**

5642 **GLASSES, TEST, on foot,** clear colorless glass.

	a	b
Capacity, ounces	2	4
Each	**$0.90**	**1.00**

3615 **GLASS BEADS,** hollow, for filtering or drying gases by means of acid ..... Per lb. 1.90



No. 5650

No. 5653

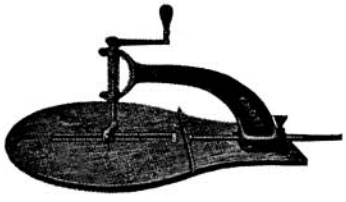
No. 5645

No. 5646

No. 5647

No. 5649

No. 5652



No. 5654

GLASS BLOWERS' FIRES. See **Blowpipes.**

5645 **GLASS CUTTER,** single steel wheel, with metal handle..... **$0.10**

5646 **GLASS CUTTER, TURRET HEAD.** Turret contains six high-grade steel wheels, hardened and tempered and carefully tested. Ebony-finished handle, nickeled ferrule, highly polished..... **.35**

5647 **GLASS CUTTER, Glazier's Diamond** with **wheel guide,** especially adapted for the unskilled. A high-grade cutter with good-sized diamond..... **7.50**

5649 **GLASS CUTTING DIAMOND,** excellent quality..... **7.50**

5650 **GLASS TUBE CUTTER, BUNSEN'S,** a practical tool with steel wheel, hardened and tempered... **.60**

5651 **GLASS TUBE CUTTER** for tubes up to ⅞-inch diameter, inexpensive but efficient, rapid and practical **.25**

5652 **GLASS TUBE CUTTER, DIAMOND,** for cutting glass tubes, water gage glasses, etc. A good sized diamond exceptionally well mounted..... **7.50**

5653 **GLASS CUTTER FOR CIRCLES.** Cuts circles from 2½ to 22½ inches in diameter. Cutter head is interchangeable, allowing renewal of cutters, and is secured firmly to the graduated rod marked to ⅛ inches. All parts nickel-plated. Hardwood handles and base with felt-covered bottom... **1.65**

5654 **GLASS CUTTER, DIAMOND, FOR CIRCLES.** For circles from ½ inch to 14 inches in diameter. Furnished with a good-sized diamond. A well-made machine of wide range of usefulness..... **28.00**

GLASS PLATES for covers. See **No. 6330.**

GLASS RODS. See **Rods, Glass, No. 6480.**

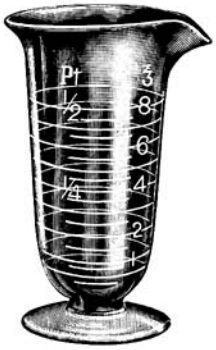
GLASS RODS, stirring rods, finished ends. See **No. 6482.**

GLASS TUBING. See **Tubing, Glass.**

5660 **GLASS WOOL** for filtering acids, etc. Per ounce **.45**

5662 **GOLD BEATERS' SKIN**..... **.10**

No. 5666



No. 5664

5664 **GRADUATES, CONICAL, graduated in ounces.**

	a	b	c	d	e	f	g
Capacity, ounces.....	½	1	2	4	8	16	32
Each.....	**$0.35**	**.40**	**.42**	**.52**	**.62**	**1.05**	**1.80**

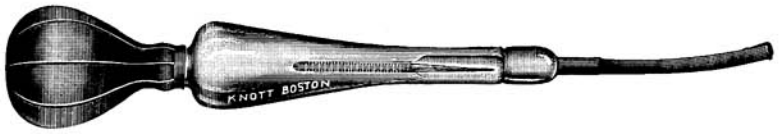
5666 **GRADUATES, CONICAL, graduated in cubic centimeters.**

	a	b	c	d	e	f
Capacity, cc.....	30	60	100	250	500	1000
Each.....	**$0.48**	**.60**	**.70**	**.95**	**1.50**	**2.15**

5667 **GRADUATES, CONICAL, graduated in both ounces and cubic centimeters.**

	a	b	c	d	e	f
Capacity, ounces.....	1	2	4	8	16	32
Capacity, cc.....	30	60	125	250	500	1000
Each.....	**$0.60**	**.75**	**.95**	**1.35**	**2.00**	**3.25**

GRADUATES, CYLINDRICAL, of glass. See page 229.



No. 5671

HEATER, ELECTRIC, WATER. See **Electric Appliances.**

HEATERS, SOLDERING IRON. See **Soldering Iron Heaters.**

HOT PLATES, See **Stoves,** and **Baths, Sand.**

HYDROMETERS

Our line of hydrometers has been selected with unusual care to cover the requirements not only of commercial, but also of educational laboratories as well. We believe we have covered general requirements. We most respectfully solicit correspondence relative to special individual requirements which are not met in the following listings.

31–170 **HYDROMETER for light liquids, double scale, Beaumé,** 100 to 10, Specific Gravity, 0.6000 to 1.000 ..... **$1.00**

31–171 **HYDROMETER for heavy liquids, double scale, Beaumé,** 0-70, Specific Gravity, 1.000 to 2.000 ..... **1.00**

31–175 **HYDROMETER, Specific Gravity Scale only, for both light and heavy liquids.** Range 0.7000 to 2.000 ..... **2.25**

5668 **HYDROMETERS, Twaddle scale,** ½° graduation.

	a	b	c	d	e	f
Range	0–24	24–48	48–72	72–100	100–134	134–180
Each	**$1.25**	**1.25**	**1.25**	**1.25**	**1.25**	**1.25**

5669 **HYDROMETERS, Specific Gravity Scale.**

	k	l	m
Range	0.700–0.800	0.800–0.900	0.900–1.000
Divisions	.002	.002	.002
Each	**$1.70**	**1.70**	**1.70**

	q	r	s	t	u
Range	1.000–1.200	1.200–1.400	1.400–1.600	1.600–1.800	1.800–2.000
Divisions	.005	.005	.005	.005	.005
Each	**$1.70**	**1.70**	**1.70**	**1.70**	**1.70**

5670E **HYDROMETER, Beaumé, heavy liquids,** 0-70° in 1° divisions **$1.75**

5670F **——, 0-50° in 1° divisions** **1.75**

5670G **——, 0-25° in ½° divisions** **1.95**

5670H **——, 0-10° in 1/10° divisions** **1.95**

5670M **HYDROMETER (Coal Oil) Beaumé, light liquids,** 10-100° in 1° divisions **1.75**

5670N **——, 10 to 45° in ½° divisions** **1.85**

5671 **HYDROMETER** for storage batteries, consisting of the hydrometer proper inside a glass tube with a rubber bulb at the top and a rubber tube at the bottom. The rubber tube may be inserted in the storage battery, a quantity of acid withdrawn into the glass tube, the reading taken and the liquid replaced within a few seconds, and with great convenience. Outfit complete **1.75**

5672 **HYDROMETERS, Specific Gravity Scale, 4-ounce size,** 6 inches long. Divisions .005.

	a	b	c	d	e	f	g	h
Range	.70–.80	.80–.90	.90–1.00	1.0–1.2	1.2–1.4	1.4–1.6	1.6–1.8	1.8–2.0
Each	**$1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**

6136 **LACTOMETER, Spence's,** New York Board of Health pattern, 0° to 120°, 2° graduation **1.25**

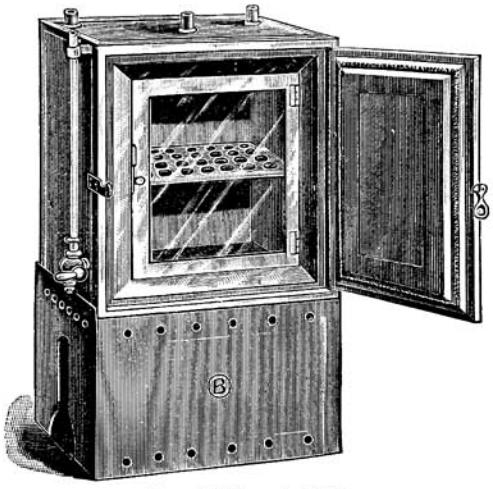
6137 **LACTODENSIMETER, Quevenne's Pattern,** scale 15° to 40° (1.015 to 1.040 Specific Gravity), 1° graduation **1.25**

31–250 **HYDROMETER JARS or CYLINDERS,** of clear white glass, with foot and rim.

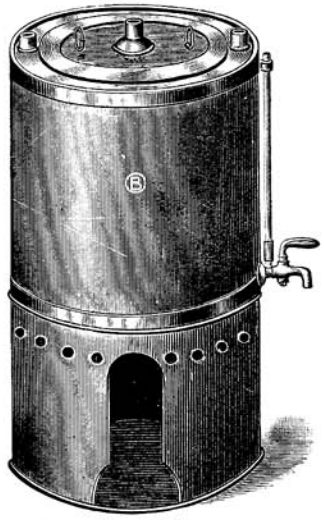
	a	b	c	d	e
Size, inches	12×1½	12×2	15×2	15×3	18×3
Each	**$1.15**	**1.25**	**1.75**	**2.00**	**3.00**

HYPERDERMIC SYRINGE. See **Syringe, Hyperdermic.**

INCUBATORS



Nos. 5680 and 5682



No. 5683

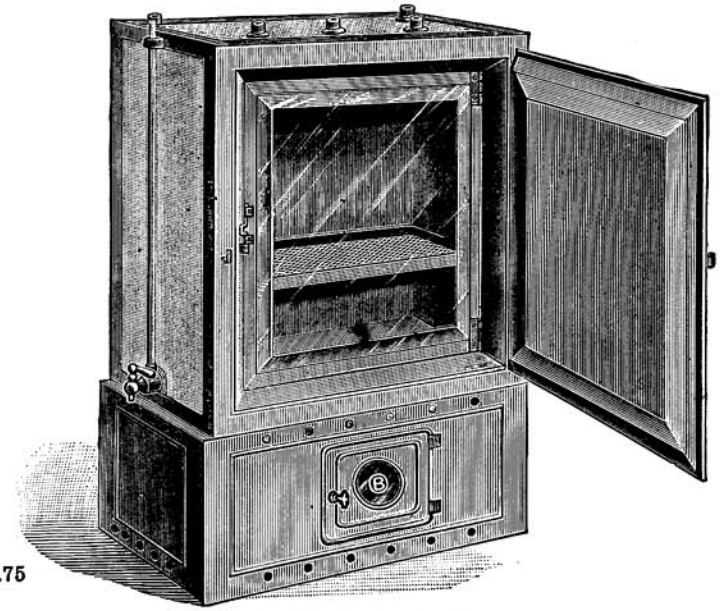
5680 **INCUBATOR, POLISHED COPPER, double wall,** sheet iron base 9 inches high — otherwise the same as the Triple Wall Incubators **Nos. 5685** to **5688.** Inside dimensions 10 inches high, 8 inches wide, 8 inches deep; outside, 13 inches high, 11½ inches wide, 11½ inches deep. With one shelf..... **$67.50**

5682 **INCUBATOR, POLISHED COPPER, double wall,** same as above, but inside dimensions, 12 inches high, 10 inches wide, 10 inches deep; outside, 15 inches high, 13½ inches wide, 13½ inches deep.... **78.00**

5683 **INCUBATOR, POLISHED COPPER, double wall,** the outer one covered with insulating material. Two-inch water space, water gauge and stopcock. Base is of sheet iron and is 9 inches high. A glass plate in the top permits of examination of contents without opening the top. Inside measurements, 8×9 inches; outside, 12×12 inches. With one perforated tray..... **27.50**

5685 **INCUBATOR, POLISHED COPPER, three wall,** having both air and water space, the outer surface being covered with insulating material to insure an even temperature. **Double doors,** the inner one of beveled glass to permit observation of cultures without disturbing the temperature. Tubulatures for gas regulator, thermometer and for filling water space.

Supported on a sheet iron base, 10 inches high, finished in durable black, having a door with an opening covered with mica for observation of the flame. Inside dimensions, 9 inches high, 7 inches wide, 7 inches deep. Outside dimensions, 13 inches high, 11 inches wide and 10½ inches deep. With one shelf..... **63.75**

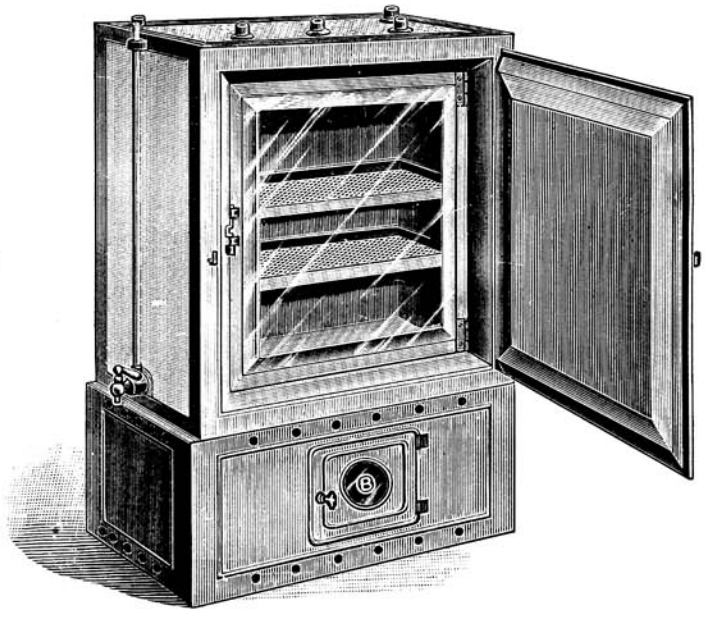


Nos. 5685 and 5686

5686 **INCUBATOR, POLISHED COPPER, three wall,** having both air and water space. Same as above, but inside dimensions 12 inches high, 9 inches wide, 9 inches deep. Outside dimensions, 17 inches high, 14 inches wide, 13 inches deep. With one shelf..... **87.50**

5687 INCUBATOR, POLISHED COPPER, three wall. Same as **No. 5685,** but inside dimensions, 14 inches high, 12 inches wide, 10 inches deep. Outside dimensions, 19 inches high, 17 inches wide, 14 inches deep. With two shelves..... **$100.00**

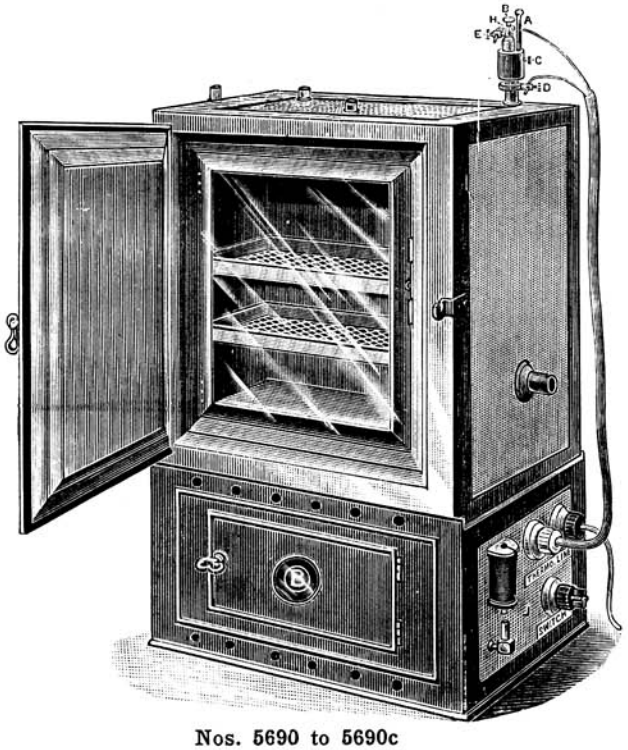
5688 INCUBATOR, POLISHED COPPER, three wall. Same as above, but inside dimensions, 20 inches high, 18 inches wide, 10 inches deep. Outside dimensions, 25½ inches high, 23¼ inches wide, 14¾ inches deep. With two shelves..... **150.00**



Nos. 5687 and 5688

INCUBATORS, ELECTRICALLY HEATED WITH ELECTRICAL CONTROL

Can be used on Direct or Alternating Current



Nos. 5690 to 5690c

The following incubators are the same sizes and have the same points of excellence as **Nos. 5685** to **5688.** They are, however, built with proper insulation for electrical heating. If at any time it should be desired to use these incubators on gas, the electric attachment may readily be removed.

The electric regulator is simple and practical in construction, and quite easily operated. When once set, it requires absolutely no attention and there will hardly be a noticeable variation in temperature. Operation by expanded mercury positively insures the finest adjustment.

5690 ELECTRIC INCUBATOR, 9×7×7 inches, inside measurements. With one shelf..... **$123.75**

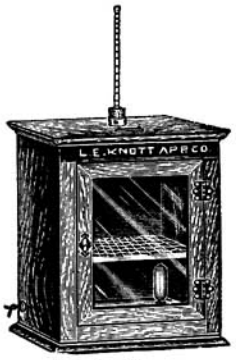
5690A ——, 12×9×9 inches, inside measurements. With one shelf **150.00**

5690B ——, 14×12×10 inches, inside measurements. With two shelves **183.00**

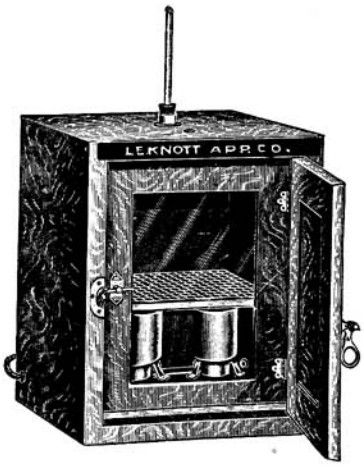
5690C ——, 20×18×10 inches, inside measurements. With two shelves **225.00**

AUTOMATICALLY CONTROLLED ELECTRIC INCUBATORS

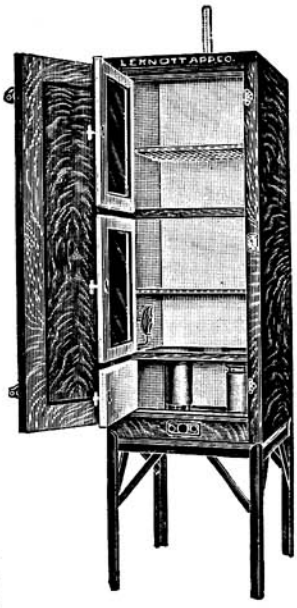
For Temperatures of 37½ degrees Centigrade



No. 5692



No. 5692B



No. 5694

These incubators are made of wood, not because they can be made cheaper than those constructed of metal, but because wood by far excels metal as an insulating medium, thus permitting direct application of heat instead of indirect heating through a water jacket. With the exception of **No. 5692** which is single-ply, all cabinets are of five-ply well-seasoned quarter sawed oak, and have an attractive hand-rubbed light oak finish. The insulation consists of tar paper, animal hair and transite. The heat medium is one or more electric carbon lamps and in the larger sizes these lamps are provided with a steel shield. An electro-thermostat is used for automatically controlling the temperature.

All incubators listed operate on either direct current or alternating current circuits, 110 or 220 volts.

The electric current and voltage should be clearly stated.

5692 ——, height 9 inches, width 7 inches, depth 7 inches, inside; one shelf, single door, without stand, ¼ ampere consumption **$38.85**

5692A ——, height 12 inches, width 9 inches, depth 9 inches, inside; one shelf, single door, without stand, ½ ampere consumption **44.45**

5692B ——, height 15 inches, width 12 inches, depth 10½ inches, inside; one shelf, double doors, without stand, ½ ampere consumption **72.25**

5692C ——, height 26 inches, width 18 inches, depth 18 inches, inside; one shelf, double doors, without stand, 1 ampere consumption **110.00**

5692D ——, same as **No. 5692C**, but **with stand** **125.00**

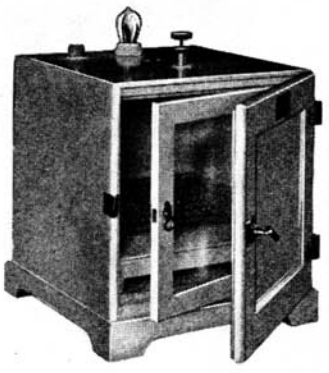
5692E ——, height 30 inches, width 20 inches, depth 18 inches, inside; three shelves, double doors, without stand, 1 ampere consumption **138.85**

5692F ——, same as **No. 5692E**, but **with stand** **152.25**

5692G ——, height 30 inches, width 36 inches, depth 18 inches, inside; three shelves, two double doors, without stand, 2 ampere consumption **250.00**

5693 ——, same as **No. 5692G**, but **with stand** **266.65**

5694 ——, height 50 inches, width 18 inches, depth 18 inches, inside; four shelves, two inner and one outer door, with stand as illustrated, one ampere consumption **222.25**



No. 5695

5695 CONSTANT TEMPERATURE ELECTRIC INCUBATOR

This incubator is built of clear well-seasoned, kiln-dried wood finished in white laboratory enamel. An inner glass door is provided to allow inspection without exposing the contents to the cold outside temperature.

The heating element is removable and covers the bottom of the chamber. It cannot get out of order or burn out. The control element or regulator, which is adjusted from outside the chamber, will maintain the temperature to within a half degree of that desired. A pilot lamp is fitted outside the chamber to enable the operator to quickly adjust the regulator to the temperature desired.

Size of chamber 12×12×12 inches. Mounted on cast iron base to set on the table. With detachable cord and plug. **$83.25**

5695A ——, same as above, but **size of chamber, 18×18×26 inches** **122.25**

5695C ——, same as **No. 5695,** but **size of chamber, 28×36×18 inches** **177.75**

5695D ——, same as **No. 5695C, but mounted on angle iron stand** to rest on the floor (see illustration of **No. 5696A**)... **200.00**

No. 5696A

5696 FREAS' CONSTANT TEMPERATURE ELECTRIC INCUBATOR, constructed of heavy asbestos wood with cast aluminum door and door frame. The interior is fitted with aluminum racks for perforated metal shelves. Inner door is of heavy glass fitted in an aluminum frame, cushioned with felt to exclude air.

Heating element is a removable wire wound resistance plate wound for 75 watts. Temperature range is from one degree above surrounding air to 70° C. The Freas' Regulator will maintain the desired temperature indefinitely to within a fraction of a degree.

Two switches are provided — one for the current — the other for the electric lamp for illuminating the chamber. **Size of chamber, 12×12×12 inches** **$155.75**

5696A ——, same as above, but **size of chamber, 16×14×16 inches,** and mounted on iron stand as illustrated **261.25**

5696B ——, same as **No. 5696A,** but **size of chamber, 18×16×18 inches** **290.00**

5696C ——, mounted on stand. Same as **No. 5696A,** but **size of chamber, 26×14×20 inches,** with two doors meeting at a center column dividing the front opening **366.75**

5696D ——, same as **No. 5696C,** but **size of chamber, 40×18×25 inches** **433.50**

5697 CONSTANT TEMPERATURE ELECTRIC "LOWTEMP" INCUBATOR for gelatine culture cultivations at 20 degrees Centigrade. May be used equally well at temperatures from 10 to 40 degrees Centigrade and lower than 10 degrees Centigrade by employing suitable cooling mixtures.

The working chamber consists of a double-walled heavy copper vessel provided with three perforated metal shelves and suitable racks for adjusting the shelves to different heights. The chamber is fitted with a glass door cushioned with felt.

The incubator body is made of wood insulated with felt, dead air spaces, etc., ten walls in all. The outside is entirely sheathed with steel plate covered with porcelain fused on at high temperature. Trimmings are polished cast aluminum.

The heating element consists of a wire wound resistance plate situated directly under the working chamber.

The regulator is operated from the outside of the chamber. A pilot lamp is fitted outside to enable the operator to quickly adjust the regulator to the desired temperature. A switch is provided for turning the current "on" or "off."

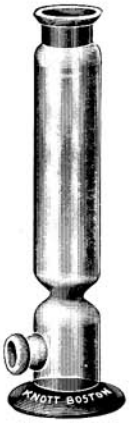
The insulation of this incubator is so perfect that one filling of the ice chamber will last for several days under normal summer laboratory temperatures. The regulator will maintain indefinitely a constant temperature to a degree Centigrade.

The incubator is mounted on a heavy iron base. **Size of working chamber, 18×15×12 inches. 438.75**

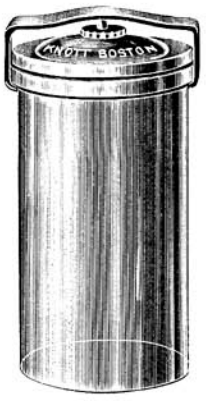
When ordering Incubators, state voltage of current.

No. 5730

No. 5727



No. 5705



No. 5715

No. 31–265

No. 5717

No. 5720

a b c
No. 6945

5700 **INK, DIAMOND,** for writing on glass, labelling bottles, beakers, etc. . . . . Per oz. **$0.85**

IRON, ELECTRIC. See **Electric Appliances.**

JARS, AQUARIA. See **Aquaria.**

31–265 **JARS, BATTERY,** of excellent quality.

	a	b	bb	c	d
Size, inches	2¼×3¼	4×5	4½×4½	6×8	8×12
Each	**$0.28**	**.40**	**.55**	**.60**	**2.25**

91–380 **JARS, BATTERY, RECTANGULAR,** of excellent quality.

	a	b
Size, inches	2½×4¼×7	4×4×8
Each	**$0.75**	**1.00**

5705 **JAR, CALCIUM CHLORIDE (Drying Tower).** Clear white glass, 10 inches high **$1.75**

5095 **JARS, GRADUATED, CYLINDRICAL.** Of glass, broad base, with lip, graduated in cubic cms.

	a	b	c	d	e	f	g
Capacity, cc.	10	25	50	100	250	500	1000
Each	**$0.42**	**.60**	**.65**	**.70**	**1.00**	**1.35**	**2.00**

5096 **JARS, GRADUATED, CYLINDRICAL, double graduations,** reading up and down. Of glass, broad base, with lip, graduated in cubic centimeters.

	a	b	c	d	e	f
Capacity, cc.	25	50	100	250	500	1000
Each	**$0.60**	**.70**	**.75**	**1.15**	**1.60**	**2.20**

5098 **JARS, GRADUATED, MIXING, STOPPERED.** Of glass, broad base, round glass stoppers, graduated in cubic centimeters.

	a	b	c	d	e	f	g
Capacity, cc.	25	50	100	200	250	500	1000
Each	**$1.20**	**1.45**	**1.50**	**1.90**	**2.10**	**3.15**	**4.20**

31–250 **JARS, HYDROMETER,** of clear white glass, with foot and rim.

	a	b	c	d	e
Size, inches	12×1½	12×2	15×2	15×3	18×3
Each	**$1.15**	**1.25**	**1.75**	**2.00**	**3.00**

5715 **JARS, MUSEUM,** for preserving and displaying specimens in laboratories and museums. Of clear colorless glass. Mouth same width as inside diameter. Contents securely sealed by a metal clamp which binds the glass cover to jar with thin rubber gasket between. On the under side of the cover are two glass rings from which specimens may be suspended.

	a	b	c	d	e
Height, without lid, inches	4	8	8	8	12
Width of mouth, inches	2¼	2¼	3½	5	5
Approximate capacity, pints	½	1	2½	5½	8
Each	**$1.65**	**1.85**	**2.50**	**4.60**	**5.50**

5717 **JAR, STAINING, COPLIN'S,** for use in staining sections for microscopic work. With glass lid ground on shoulder. For ten slides . . . . . **.50**

6945 **JARS, NESSLER,** for ammonia tests in water analysis; of colorless glass.

	a	b	c
Graduated, cc.	50	100	50 and 100
Each	**$0.75**	**.90**	**1.10**

5720 **JARS, SHOW, INVERTED,** clear, colorless glass.

	a	b	c	d
Capacity, pints	½	1	2	4
Each	**$0.50**	**.60**	**.90**	**1.60**

5727 **JARS, STORAGE, "Lightning Sealing,"** for chemical, biological and botanical specimens.

	a	b	c	d
Capacity, pints	½	1	2	4
Each	**$0.18**	**.22**	**.24**	**.28**

5730 **JAR, WASTE, stoneware.** Capacity 3 gallons, with cover and handles **1.80**

No. 5765

5750 **LABELS, GUMMED, red border,** in boxes.

Trade No.	217	213	209	205	201	2004	2007	2002	2001	2005	2003
Length, inches	1	1¼	1½	1¾	2½	2¾	3	3⅞	3⅞	4⅛	4¾
Width, inches	⅞	1	1⅛	1⅜	1½	1	1⅝	1⅛	1⅝	2	2
Per box	**$0.10**	**.10**	**.10**	**.10**	**.10**	**.20**	**.25**	**.25**	**.30**	**.35**	**.45**

5753 **LABELS, GUMMED, perforated, in rolls,** 1000 labels in a roll. Numbers given are same sizes as above. Each roll contained in a special box with slot opening so that labels can be drawn out as needed without opening the box.

	a	b	c	d
Trade No.	205	209	217	223
Per roll	**$1.25**	**1.15**	**1.10**	**1.00**

5758 **LABELS, CHEMICAL,** in book, names and symbols for all chemicals and reagents in general use in laboratories. Gummed and perforated so that any label may be removed without destroying the book. . . . . Per book **$0.75**

5760 **LABELS, MICROSCOPIC SLIDE,** ½×⅞ inch, gummed . . . . . Per box **.15**

5761 **LABELS, MICROSCOPIC SLIDE,** ⅞×⅞ inch, gummed, black border . . . . . Per box **.15**

LACTOMETERS. See **Milk-Testing Apparatus.**

5765 **LADLE, COPPER** with **wood handle.** Diameter of bowl 1½ inches, depth 1¼ inches, extreme length 8 inches . . . . . **.55**

5766 **LADLE, IRON,** for melting. Ladle and handle are one casting; bowl 4 inches diameter . . . . . **.75**

No. 5769

No. 5770

No. 5773

5769 **LAMP, ALCOHOL, wick feed,** for denatured alcohol. This lamp produces perfect combustion and burns with an intensely hot blue flame. Regulates perfectly, is odorless and sootless. **3.25**

5770 **LAMPS, ALCOHOL,** of colorless glass, with ground glass cap, wick and wick holder.

	a	b
Capacity, ounces	4	8
Each	**$0.40**	**.60**

5770A **LAMP WICKS** for above glass alcohol lamps . . . . . Per dozen **.50**

5773 **LAMP, POLISHED BRASS, ALCOHOL, nickel-plated.** Capacity 2 ounces **1.00**

LEAD DISHES. See **Dishes, Lead.**

5780 **LITMUS PAPER, red,** in sheets . . . . . Per sheet. **.10** Per quire **.75**

5781 **LITMUS PAPER, red,** in books of strips . . . . . Per book **.10**

5782 **LITMUS PAPER, blue,** in sheets . . . . . Per sheet **.10** Per quire **.75**

5783 **LITMUS PAPER, blue,** in books of strips . . . . . Per book **.10**

5789 **LITMUS PENCIL** . . . . . **.35**

5795 **LOGARITHM TABLES,** a heavy board card, 14½×9½ inches, with four place tables of logarithms and anti-logarithms, with table of atomic weights, also Factors for Analysis. Computed by Dr. Hubert G. Shaw. This card is of convenient size for students' use in the laboratory. Used extensively and for years at the Massachusetts Institute of Technology . . . . . Each **.45**

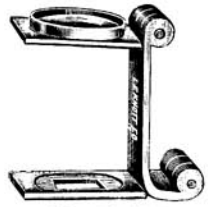
MAGNIFIERS

Our line of magnifiers has been selected with the greatest care. We list below types that have succeeded best in meeting the diversified requirements of science laboratories and feel, therefore, that our customers will be able to select the type or types best suited to their particular needs.

No. 5815

No. 5821

No. 5824



No. 74–235

5815 **MAGNIFIER, TRIPOD,** giving a large, clear field and a magnification sufficient for elementary work. The lens may be focussed by screwing it up and down in its frame..... **$0.85**

5819 **MAGNIFIER, POCKET, single,** 1 inch in diameter, mounted and encased in vulcanite..... **1.50**

5821 **——, double,** ⅞ and 1-inch lenses, mounted and encased in vulcanite..... **1.85**

5824 **——, triple,** ½, ⅝ and 1¾-inch, lenses mounted and encased in vulcanite **2.50**

74–235 **MAGNIFIER, FOLDING (linen tester),** brass mounted, short focus, ½-inch aperture..... **.60**

74–230 **MAGNIFIER, READING (Reading Lens),** diameter 3 inches, in nickel-plated brass mount, polished wood handle..... **2.00**

Nos. 5835 to 5839

Nos. 5847 to 5851

Doublet Magnifiers. These magnifiers are composed of two separate plano-convex lenses, very carefully and accurately ground and polished and substantially set in their mounts. **Nos. 5835 to 5839** are black lacquered and **Nos. 5847 to 5851** are nickel-plated. Excellent definition and an exceptionally flat field with greatest focal length are characteristics of these lenses.

For use on Dissecting Stands.

5835 **6X DOUBLET MAGNIFIER,** 41.6 mm. (1.6 inches) focal distance, working distance 22 mm., field 22 mm..... **$1.75**

5836 **9X DOUBLET MAGNIFIER,** 27.8 mm. (1.1 inch) focal distance, working distance 15 mm., field 16 mm. **1.75**

5837 **12X DOUBLET MAGNIFIER,** 20.8 mm. (0.8 inch) focal distance, working distance 12 mm., field 11 mm..... **1.75**

5838 **18X DOUBLET MAGNIFIER,** 13.9 mm. (0.5 inch) focal distance, working distance 8 mm., field 8 mm. **1.75**

5839 **24X DOUBLET MAGNIFIER,** 10.4 mm. (0.4 inch) focal distance, working distance 6 mm., field 5.5 mm..... **2.25**

In Folding Pocket Cases.

5847 **6X DOUBLET MAGNIFIER,** 41.6 mm. (1.6 inches) focal distance, working distance 22 mm., field 22 mm..... **2.00**

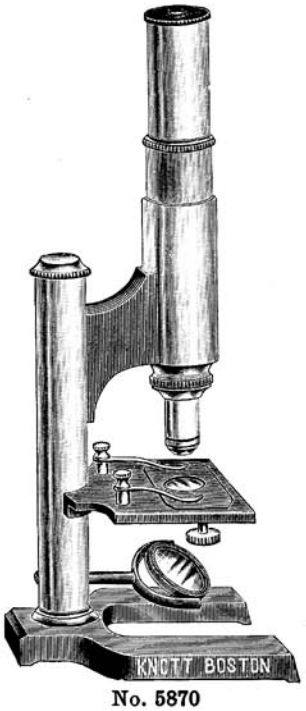
5848 **9X DOUBLET MAGNIFIER,** 27.8 mm. (1.1 inches) focal distance, working distance 15 mm., field 16 mm..... **2.00**

5849 **12X DOUBLET MAGNIFIER,** 20.8 mm. (0.8 inch) focal distance, working distance 12 mm., field 11 mm..... **2.00**

5850 **18X DOUBLET MAGNIFIER,** 13.9 mm. (0.5 inch) focal distance, working distance 8 mm., field 8 mm. **2.25**

5851 **24X DOUBLET MAGNIFIER,** 10.4 mm. (0.4 inch) focal distance, working distance 6 mm., field 5.5 mm. **2.50**

COMPOUND MICROSCOPES



No. 5870

The microscopes listed as follows with the exception of **Nos. 5868** and **5870** are the product of the Spencer Lens Company. The best of material is used and is worked by the best modern machinery in the hands of men of skilled mechanics, carefully trained, each to his particular work.

The stands are for the most part in a neat black finish which is baked in at a high temperature and which is resistant to wear, to acid. to alcohol, and all the common reagents. This effect is heightened by the yellow finish of the smaller parts. This yellow finish is also alcohol and reagent proof.

We call particular attention to features which are peculiar to these microscopes.

Unexcelled Optics.
Fine adjustments are automatically lubricated and protected from dust.
All fine adjustments are so protected that no harm can come to them from handling the microscope by the arm.
All fine adjustments cease to work when the objective rests on the cover glass.
No lost motion or lateral displacement in either type of fine adjustment.
Unusually large stages on which the vulcanite stages are vulcanized directly to the metal stage.
Unexcelled optical and mechanical workmanship throughout.

5868 COMPOUND MICROSCOPE, SMALL. This microscope, though but 7 inches high, is an efficient compound microscope for the general work of a school laboratory. Constructed of brass throughout and handsomely finished. Stage is large and provided with nickel-plated spring clips. Furnished with ocular and three objectives giving magnifications of 30, 50 and 80 diameters. In box with receptacle for slides and forceps..... **$15.00**

5870 COMPOUND MICROSCOPE, a low-priced instrument of exceptionally fine quality well adapted for school laboratories. It is a full size instrument conforming to standards by Royal Microscopical Society, and objectives and oculars of any other make conforming to the same standards, may be added to its equipment.

Stage, 2¾ × 2⅞ inches, has attached to it a supplementary micrometer stage affording a very delicate fine adjustment with nickel-plated spring stage clips.
Stand is made entirely of brass, handsomely finished in lacquer and black enamel. The **draw tube** is 160 mm. long and is nickel-plated and polished where it slides in the main tube.
Mirror is plane, 1⅛ inches diameter, so mounted that it can be adjusted to any angle.

With a 7X ocular and a 2/3 and 1-inch divisible objective in case... **23.50**

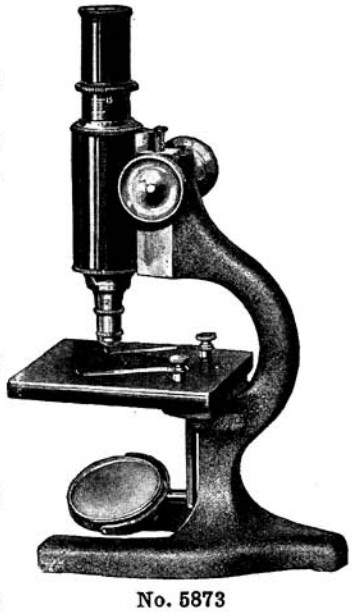
COMPOUND MICROSCOPES, suggested for commercial, household or elementary school purposes where the magnification required is not great.

Focussing adjustment, coarse adjustment only, by rack and pinion.
Stage of brass, black lacquered. Measures 112 × 108 mm. and distance of optical axis to base of arm is 75 mm.
Mirror, plano-concave, 50 mm. diameter, on swing bar.

5873 ——, with **divisible objective 32-14 mm.** and **10X ocular** giving magnifications of 35 and 130 diameters..... **31.50**

5873A ——, with **divisible objective 32-14 mm.** and **5 mm. special objective** and **6X and 10X oculars** giving magnifications of 17, 35, 65, 130 and 360 diameters..... **42.50**

5873B ——, same as above, but with **revolving dust-proof double nosepiece**..... **49.50**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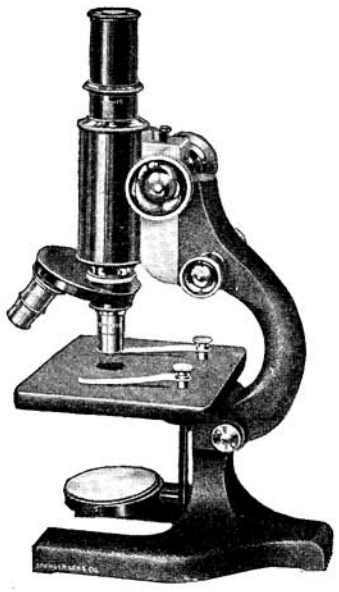

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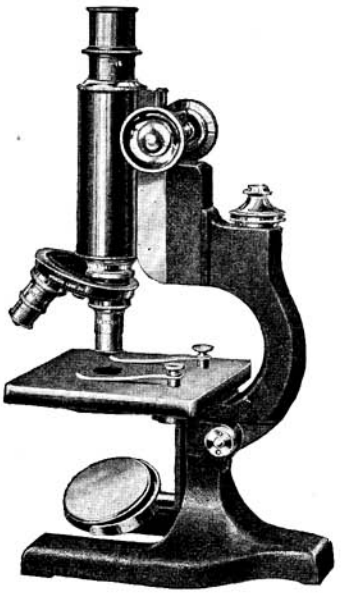

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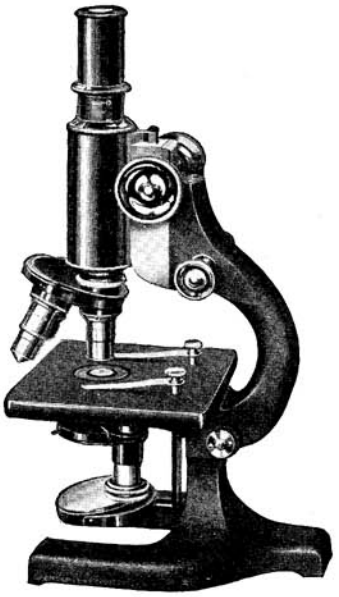


No. 5880F

COMPOUND MICROSCOPES, side fine adjustment. Stage 108 mm. deep by 112 mm. wide, with iris diaphragm in the stage. **Plano-concave mirror,** 50 mm. diameter. **Coarse and fine adjustments.** The fine adjustment located on the side is of the simplest possible construction and cannot get out of order — one complete revolution of the shaft raises or lowers the body tube 0.2 mm.

5876A ——, with **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 10X ocular giving magnifications of 100 and 440 diameters **$64.00**

5876C ——, with **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 6X and 10X oculars giving magnifications of 60, 100, 264 and 440 diameters **66.50**

5876D ——, with **Abbe Condenser** (N.A. 1.20) and **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 10X ocular giving magnifications of 100 and 440 diameters **76.00**

5876E ——, same as above but with the addition of a 6X ocular giving additional magnifications of 60 and 264 diameters **78.50**

COMPOUND MICROSCOPES, top lever type, fine adjustment. Stage 112×108 mm., with iris diaphragm beneath the stage. **Plano-concave mirror,** 50 mm. diameter. **Coarse and fine adjustments** — one complete revolution of fine adjustment raises or lowers the body tube 0.5 mm.

5878A ——, with **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 10X ocular, giving magnifications of 100 and 440 diameters. **60.50**

5878C ——, same as above, but with the addition of a 6X ocular giving additional magnifications of 60 and 264 diameters **63.00**

5878D ——, with **Abbe Condenser** (N.A. 1.20) and **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 10X ocular giving magnifications of 100 and 440 diameters **72.50**

5878E ——, same as above, but with the addition of a 6X ocular giving additional magnifications of 60 and 264 diameters **75.00**

5878F ——, with **Substage Abbe Condenser** (N.A. 1.20) **revolving dust-proof triple nosepiece,** 16 and 4 mm. objective, 1.8 mm. oil immersion objective, and 6X and 10X oculars, giving magnifications of 60, 100, 264, 440, 570 and 950 diameters **119.50**

COMPOUND MICROSCOPES, side fine adjustment of simple and practical construction — cannot get out of order. One complete revolution of shaft moves body tube 0.2 mm. Stage, 112×108 mm. Optical axis to arm is 80 mm. **Plano-concave** mirror, 50 mm. diameter. Condenser, when supplied, is standard quick screw form with iris diaphragm beneath. The upper iris diaphragm is automatically locked open when condenser is in place.

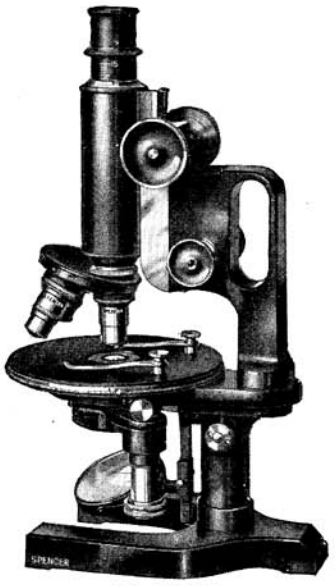
5880A ——, with **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 10X ocular, giving magnifications of 100 and 440 diameters **73.00**

5880C ——, same as above but with the addition of a 6X ocular giving additional magnifications of 60 and 264 diameters **75.50**

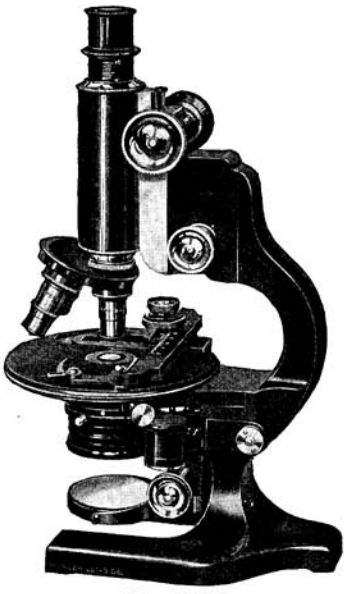
5880D ——, with **Abbe Condenser** (N.A. 1.20), **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 10X ocular giving magnifications of 100 and 440 diameters **85.00**

5880E ——, same as above, but with the addition of a 6X ocular giving additional magnifications of 60 and 264 diameters **87.50**

5880F ——, with **Abbe Condenser** (N.A. 1.20) **revolving dust-proof triple nosepiece,** 16 and 4 mm. objectives, 1.8 mm. oil immersion objective and 6X and 10X oculars, giving magnifications of 60, 100, 264, 440, 570 and 950 diameters **132.00**



No. 5883D



No. 5885D

COMPOUND MICROSCOPE suggested for advanced laboratory research work and clinical work of the most exacting character.

Side fine adjustment having no lost motion and no side thrust, automatically taking up for any wear as it may occur. Each of the one hundred divisions of the graduated button represents a movement of 1 micron.

Stage, 120 mm. diameter, is of brass, covered top and edges with rubber vulcanized directly to the stage plate.

Substage. A sextuple screw, protected from dust, carries the substage arm up and down on a perpendicular axis, around which the arm is free to revolve when at the lower limit of the screw. When at the lower limit, the arm may be swung out of the optical axis, carrying with it the small iris diaphragm fastened to its upper surface, and also the condenser with its larger iris. The small upper iris is automatically locked open when the condenser is in place.

5883A **COMPOUND MICROSCOPE** with **Abbe Condenser** (N. A. 1.20), **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 10X ocular, giving magnifications of 100 and 440 diameters **$121.00**

5883C ——, same as above, but with the addition of a 6X ocular giving additional magnifications of 60 and 264 diameters **123.50**

5883D ——, with **Abbe Condenser** (N.A. 1.20), **revolving dust-proof triple nosepiece,** 16 and 4 mm. objectives, 1.8 oil immersion objective and 6X and 10X oculars, giving magnifications of 60, 100, 264, 440, 570 and 950 diameters **168.00**

COMPOUND MICROSCOPE suggested to micro-biologists who demand a large and very efficient instrument where critical work is a necessity.

Side fine adjustment having no lost motion and no side thrust; automatically taking up for any wear as it may occur. Each of the one hundred divisions of the graduated button represents a movement of 1 micron.

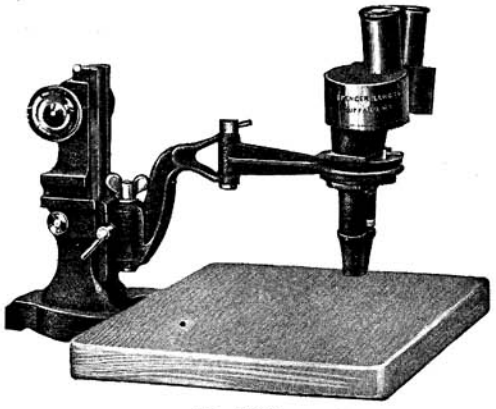
Revolving Stage, 120 mm. in diameter, is covered with vulcanite; axis of revolution is 90 mm. from the arm. Provided with mechanical stage, buttons of which are on concentric axes; lateral movement 60 mm., to-and-fro movement 38 mm.

Sub-stage. May be moved up and down on its bearing by rack and pinion. The iris diaphram beneath the condenser is located on one arm, which swings to the right and on which provision is made for oblique light, the decentering secured by rack and pinion. The condenser is of the drop swing type. The upper iris diaphragm is located on one arm which swings to the left. The mirror is mounted on a swing arm mounted independent of the stage.

5885A **COMPOUND MICROSCOPE** with **Abbe Condenser** (N.A. 1.40), **revolving dust-proof double nosepiece,** 16 and 4 mm. objectives and 10X ocular, giving magnifications of 100 and 440 diameters **$198.00**

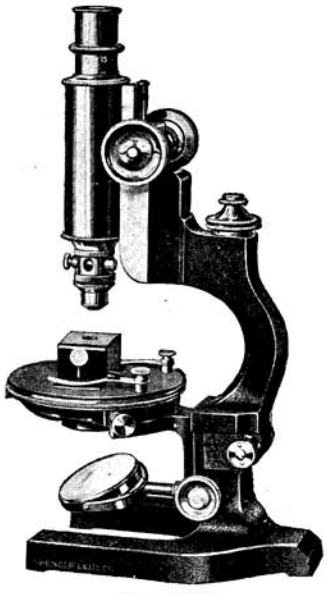
5885C ——, same as above, but with the addition of a 6X ocular giving additional magnifications of 60 and 264 diameters **200.50**

5885D —— with **Abbe Condenser** (N. A. 1.40), **revolving dust-proof triple nosepiece,** 16 and 4 mm. objectives 1.8 mm. oil immersion objective, and 6X and 10X oculars, giving magnifications of 60, 100, 264, 440, 570 and 950 diameters **245.00**



No. 5890

With stage removed and arm extended over board covering base.



No. 5895

BINOCULAR MICROSCOPE, CONVERTIBLE — a binocular microscope whose adaptability and utility has not been equalled.

Features. The **patent cast metal unit mount** of the objectives protects them so that it is impossible for them to get out of adjustment — an arm **composed of two** jointed sections The joints may be securely locked in any position, which feature with the use of inclination joint, also, **provides for examining surfaces.**

The stage, 127 × 114 mm., is a metal frame work which may easily be removed or attached to the base just above the inclination joint and securely set with a single set screw.

Pupillary distance of 48 mm. A shutter which automatically remains open may be turned to shut off the light from either eye. Objectives accurately paired.

5890 ——, with 40 mm. paired objectives and 10X paired oculars **$120.00**

5890A ——, with 48 and 32 mm. paired objectives and 6X and 10X oculars..... **145.00**

5890B ——, with 55, 40 and 25 mm. paired objectives and 4X, 6X and 10X oculars..... **170.00**

5890C ——, with 55, 48, 32 and 25 mm. paired objectives and 4X, 6X and 10X oculars **190.00**

5890D ——, with 55, 48, 40, 32 and 25 mm. paired objectives and 4X, 6X and 10X oculars **210.00**

METALLURGICAL MICROSCOPE, lever type top, fine adjustment— one complete revolution of the shaft moves the body tube 0.5 mm. Arm and pillar give a **working radius of 85 mm.** from optical axis to the arm. **Stage is 120 mm. in diameter.** A removable disc at the center may be racked up and down through a distance of 45 mm. If desired, this stage may be removed entirely.

With the outfits listed below, the **Vertical Illuminator No. 5971** and a small frame by which metals may be held with the polished side upwards are included.

5895 ——, **without nosepiece,** with 16 and 4 mm. objectives and 10X ocular..... **$180.00**

5895A ——, with **revolving dust-proof double nosepiece**..... **186.25**

5895C ——, same as above but with the addition of a 6X ocular..... **188.75**

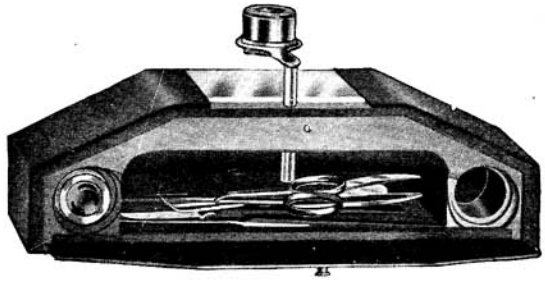
5895D ——, with **revolving dust-proof triple nosepiece,** 32, 16 and 4 mm. objectives and 6X and 10X oculars **198.00**

5905 **DISSECTING MICROSCOPE, Regent's Type,** complete with lens..... **4.25**

DISSECTING MICROSCOPE, BLOCK, with hollow center designed as a receptacle for dissecting tools and magnifiers. This is closed by a door hinged at the lower end. Heavy glass stage with a black and a white background for use beneath the stage.

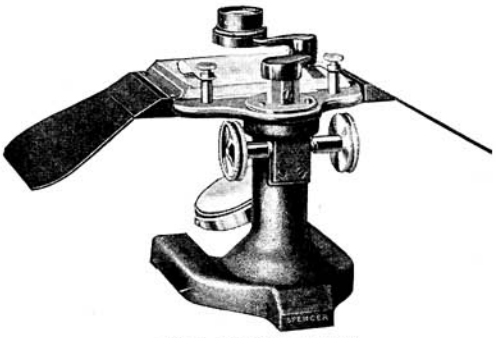
5907 ——, with **9X Doublet Magnifier** giving a magnification of 9 diameters, equivalent focus 27.8 mm., working distance 15 mm... **$5.50**

5908 ——, with **6X and 12X Doublet Magnifiers** giving magnifications of 6 and 12 diameters, equivalent foci 41.6 and 20.8 mm. and working distances of 22 and 12 mm. respectively..... **7.25**

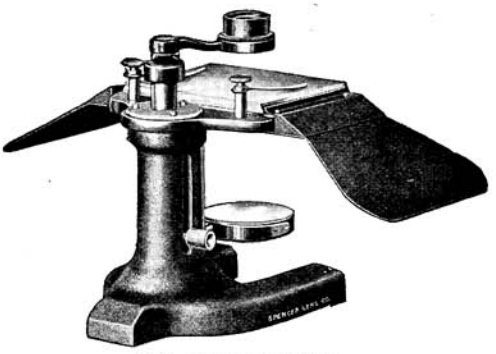


No. 5907 Back View

DISSECTING MICROSCOPES



Nos. 5910 to 5910C



Nos. 5912 to 5912C

DISSECTING MICROSCOPES

Rack and Pinion Focussing Adjustment

Stage 75×100 mm. Covered by a heavy polished glass plate with a black and a white background to fit beneath the plate. Metal hand rests; jointed lens carrier permits of use of lens on any part of the stage; plano-concave mirror 50 mm. in diameter. In handsome cabinet.

5910 **DISSECTING MICROSCOPE,** with **9X doublet magnifier,** magnification 9 diameters. Equivalent focus of 27.8 mm. and a working distance of 15 mm. **$16.25**

5910A ——, with **6X and 12X doublet magnifiers,** magnifications of 6 and 12 diameters. Equivalent foci of 41.6 and 20.8 mm. respectively, and working distance of 22 and 12 mm. respectively **18.00**

5910B ——, with **9X Triple Aplanat Magnifier,** magnification 9 diameters. Large flat field and great working distance, equivalent focus 27.8 mm., working distance 24.5 mm. **20.75**

5910C ——, with **6X and 12X Triple Aplanat Magnifiers** having magnifications of 6 and 12 diameters. Large flat fields and great working distances. Equivalent foci 41.6 and 20.8 mm. and working distances of 36.8 and 18.4 mm. respectively **27.00**

DISSECTING MICROSCOPES

Focussing Accomplished by Button on Side of Pillar

Stage 75×100 mm. Covered by a heavy polished glass plate with a black and a white background to fit beneath the plate. Metal hand rests; jointed lens carrier permits of use of lens on any part of the stage; plano-concave mirror 50 mm. in diameter. In handsome cabinet.

5912 **DISSECTING MICROSCOPE,** with **9X doublet magnifier** giving a magnification of 9 diameters, equivalent focus 27.8 mm., working distance 15 mm. **$14.50**

5912A ——, with **6X and 12X Doublet Magnifiers,** giving magnifications of 6 and 12 diameters, equivalent foci 41.6 and 20.8 and working distances 22 and 12 mm. respectively **16.50**

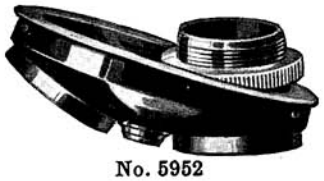
5912B ——, with **9X Triple Aplanat Magnifier,** giving magnification of 9 diameters. Large flat field and long working distance, equivalent focus 27.8 mm., working distance 24.5 mm. **19.00**

5912C ——, with **6X and 12X Triple Aplanat Magnifiers,** giving magnifications of 6 and 12 diameters; exceptionally sharp definitions, large, clear and flat fields and long working distances. Equivalent foci 41.6 and 20.8 mm., working distances 36.8 and 18.4 mm. respectively **25.25**

16 mm.

4 mm.

1.8 mm.



No. 5952

No. 5953

Abbe Condenser and Mounting

Nos. 5960 to 5961

ACHROMATIC OBJECTIVES

These objectives are all corrected for a tube length of 160 mm. and for a cover glass thickness of 0.18 mm. They give a sharp critical definition to the edge of the field and at the same time give exceptional long working distance and unusual flatness of field. All objectives are made with the Society Screw furnished by the Royal Microscopical Society and are interchangeable with those of European manufacture. All objectives are mounted directly into the model and are thus unharmed when cleaned with a solvent.

Catalogue No.	Equivalent Focus		Num. Aperture	Working Distance*	Diam. of the † real field	Price
	mm.	inches approx.		With 160 mm. tube length and 10x eye piece mm.	mm.	Fixed Mount.
5920	48	2	0.10	28.0	6.5	**$6.50**
5922	32	1⅜	0.10	15.0	4.7	**6.50**
5925	25	1	0.25	9.5	3.3	**8.50**
5926	16	⅔	0.25	5.0	2.1	**8.50**
5928	8	⅓	0.50	1.5	1.0	**13.00**
5930	4	1/6	0.85	0.46	0.40	**13.00**
5931	3	1/8	0.85	0.26	0.30	**13.00**
5933	Oil-Im. 1.8	1/14	1.25	0.13	0.20	**42.00**
5934	Oil-Im. 1.5	1/16	1.25	0.10	0.14	**56.00**
5936	Fluorite 2 Oil-Im.	1/12	1.25	0.17	0.16	**75.00**

*Working distance is the distance between the front lens and cover glass.

†Real field is the distance of the circular area seen through the microscope and measured in the plane of the object.

HUYGHENIAN OCULARS. These oculars all fit the standard tube adopted by Royal Microscopical Society and are interchangeable with those of European manufacture. The terms 4X, 6X, 8X, 10X, etc., designate the magnification based on the size of the image projected the distance of distinct vision, i.e. 250 mm. (10 inches).

Cat. No.	**5940**	**5941**	**5942**	**5943**	**5944**	**5945**
Equivalent Focus	62.5 mm. (2½″)	50 mm. (2″)	40 mm. (1⅗″)	30 mm. (1⅕″)	25 mm. (1″)	20 mm. (⅘″)
Each	**$2.50**	**2.50**	**2.50**	**2.50**	**2.50**	**2.50**

REVOLVING DUST-PROOF NOSEPIECES, most carefully made and greatest care exercised to see that they are perfectly centered and are strong enough to remain so. Neatly finished in alcohol-proof enamel, with the focal lengths of the objectives used neatly engraved on the edge of the revolving portion.

5952 REVOLVING DUST-PROOF NOSEPIECE, double **$6.50**

5953 ——, triple **9.00**

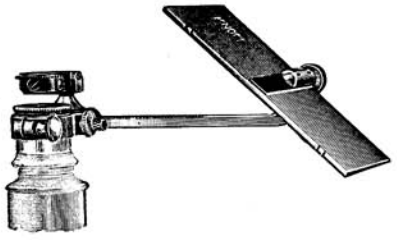
5954 ——, quadruple **11.00**

SUBSTAGE ABBE CONDENSERS. These are non-achromatic lenses mounted with an iris diaphragm beneath to modify the amount of light and with a ring beneath the iris to hold a blue glass for cutting out the yellow rays of artificial light.

5960 ABBE CONDENSER, N.A. 1.20 ..... **$12.00**

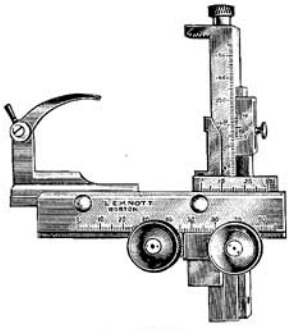
5961 ——, N. A. 1.40 ..... **14.50**

MICROSCOPE ACCESSORIES



No. 5968

No. 5971



No. 5975

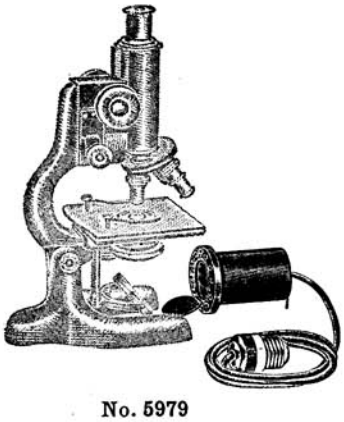
5968 **ABBE CAMERA LUCIDA.** Shows the whole of the field, the object, and the pencil point. Adjustment provided for securing exact focus, for centering prism, and for modifying the light. Mirror, 70×105 mm., adjustable on a graduated mirror bar. In case **$30.00**

5969 ——, similar to above, but **prism is permanently centered,** and there is no adjustment for modifying the light from the ocular **18.00**

5971 **VERTICAL ILLUMINATOR.** This instrument is constructed to screw into the nosepiece, between it and the objective. The light is directed into the opening in the side until it strikes the silvered surface from which it is reflected down through the objective to the object to be examined. It is then reflected back through the objective to the eye. The opening in the side is so arranged that it can be turned in any direction. With silvered prism for reflecting the light **13.25**

5972 ——, **with silvered cover glass for reflecting the light.** Provided with three openings of different sizes **13.25**

5975 **MECHANICAL STAGE,** new construction, so made that the vernier reading designating the locations of objects taken on one microscope will register with the readings for the same objects taken on any other microscope. This feature is made possible from the fact that the vernier for the vertical movement and the arms holding the slide are adjustable. The stage will handle a slide 3×2 inches. Range 85 mm. lateral motion and 65 mm. vertical. In mahogany case **30.00**



No. 5979

No. 5980

5979 **MICROSCOPE ILLUMINATOR.** Can be used in ordinary way as illustrated, but originally designed (embedded in the top of the table) for obtaining direct light. When used as illustrated for reflected light, the hinged leg support is used which can be folded out of the way when not in use. When embedded in table top, a cover is provided for closing the hole in the top.
Dimensions — length, 4 inches; largest diameter, $2\frac{9}{16}$ inches; smallest diameter, 2 inches.
Illumination from 15 watt gas-filled filament lamp with reflector. With attachment plug and cord. **7.25**

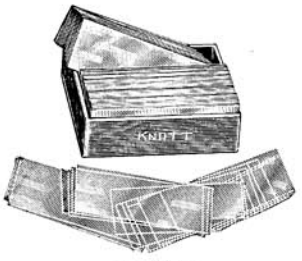
5980 **MICROSCOPE LAMP.** It works on any incandescent circuit, but must always be provided with a rheostat suitable for the voltage. Provided with one blue and one ground-glass plate, both of which fit into a groove in front of the condenser. Complete with five feet of connecting cord **23.50**

5980A **FIXED RHEOSTAT** for 110 volts — 5 amperes **8.75**

5980B ——, for 220 volts — 5 amperes **12.00**

5980C **CARBONS** for use in above lamp ..... Each **.06**

MICROSCOPIC SLIDES AND ACCESSORIES



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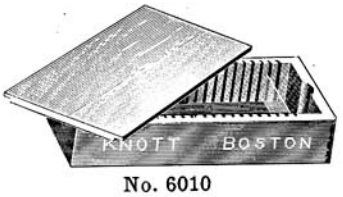

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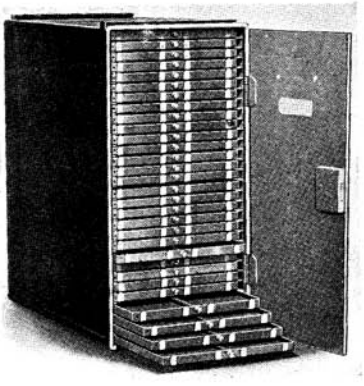

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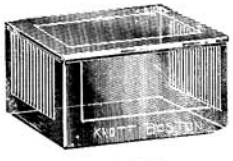
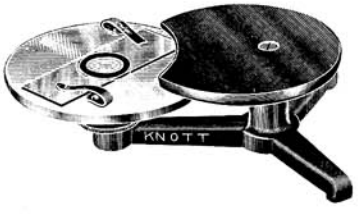


No. 6000



No. 6005

COVER GLASSES

We have long been headquarters for the greatest variety of cover glasses, round, square or rectangular. Our stock, despite the shortage due to unusual conditions, is quite complete. **Specify** not only by **catalogue number**, but give also **shape, thickness number, size and quantity.**

CIRCULAR COVER GLASSES

	Thickness No.	Diameter	Per Fifty
5985B	2	15 mm. (⅝-inch)	**$0.30**
5985D	2	12 mm. (½-inch)	**.20**

5986 **COVER GLASSES, CIRCULAR,** 18 mm. (¾-inch) diameter.....Per ½ ounce **$1.10**

RECTANGULAR COVER GLASSES

	Thickness No.	Dimensions	Per Fifty
5988B	1	12×12 mm.	**$0.20**
5988C	2	12×12 mm.	**.20**
5988E	1	32×32 mm.	**1.00**
5988F	1	35×35 mm.	**1.35**
5988G	1	22×40 mm.	**1.30**
5988I	1	15×45 mm.	**1.10**

5989 **COVER GLASSES, SQUARE,** 18×18 mm. (¾×¾-inch).....Per ½ ounce **$1.10**

5990 **SLIDES, MICROSCOPIC, GLASS,** 3×1 inch, ground edges.....Per gross **2.50**

5992 **SLIDES, GLASS, concave centers**.....Per dozen **1.50**

5995 **LIFE SLIDE, HOLMAN'S,** a deep cylindrical cavity connected by a small channel with a more shallow beveled cavity. Complete with cover..... **2.50**

6000 **SLIDE BOX AND COVER, GLASS,** for use in staining sections. Width $2\frac{5}{16}$ inches, length $3\frac{3}{16}$ inches **.45**

STAINING JAR. See **Jars.**

6005 **TURN TABLE,** finely centered, all adjustments for preparing microscope slides..... **6.50**

6010 **SLIDE BOX,** of white wood, with closely fitting cover, grooved, to hold 25 slides, numbered and indexed..... **.17**

6012 **SLIDE BOX** for 100 slides. Covered with a heavy cloth. Hinged cover with two catches..... **1.10**

6014 **SLIDE CABINET, MINOT'S METAL,** a most compact fire-proof receptacle for storing slides. Constructed of metal throughout, neatly finished, inside and outside, with japan. Contains 30 japanned metal trays, each having a capacity for 24 slides. Each tray with knob and card holder. The cabinet is provided with brass lock. Size 36.5 cms. high, 32.5 cms. deep and 17.5 cms. wide, outside measurements.
Complete with 30 trays..... **45.00**

SLIDES, PREPARED MICROSCOPE MOUNTS

ZOOLOGY

6020 Knott's Prepared Microscope Mounts for Zoology:

a Skeleton of Commercial Sponge $0.60
b Transverse section of Sponge Grantia showing flesh and spicules ..... .60
c Fresh Water Hydra, entire ..... .70
d Transverse section of Fresh Water Hydra
Ectoderm
Mesoderm
Endoderm ..... .90
e Campanularian Hydroid (Obelia) ..... .60
f Tubularian Hydroid (Pennaria) ..... .60
g Transverse section of Sea Anemone (Metridium marginatum) showing plan of body structure of coral polyp ..... .60
h Pedicellaria of Echinoderm (Starfish or Sea Urchin) ..... .60
i Amœba 1.25
j Transverse section of Earthworm ..... .60
k Circumœsophageal nerve ring and part of ventral nerve-cord of Earthworm 1.20
l Transverse section through heart of Clam ..... .60
m Transverse section through gill of Clam ..... .70
n Mouth parts of biting Insect; Labrum, Mandibles, Maxillæ, Maxillary palpi, Labium, and Labial palpi ..... .85
o Proboscis of House Fly ..... .60
p Wing of Fly ..... .60
q Spiracle of Cricket ..... .60
r Tracheæ of Insect ..... .60
s Scales on Wing of Moth ..... .60
t Section through Compound Eye ..... .70
u Gizzard of Cricket ..... .60
v Mouth Parts of Honey Bee ..... .80
w Blood of Fish ..... .70
x Blood of Frog ..... .70

6021 Complete Set, as listed above 15.00

PHYSIOLOGY

6023 Knott's Prepared Microscope Mounts for Physiology:

a Blood, Human $0.85
b Blood, Frog, double stained ..... .70
c Bone, longitudinal section, showing Haversian canals, canaliculi and lacunæ 1.00
d Bone, transverse section, showing Haversian systems, etc. 1.00
e Cerebrum, section showing white and gray matter, etc. ..... .60
f Cerebellum, showing
1 Cortical layer of gray matter.
2 White matter of medulla, white medullary substance, the granule layer, the molecular stratum, and the layer of the cells of Purkinji ..... .60
g Stomach, transverse section, showing the general arrangement of its coats.
1 Mucosa containing tubular peptic glands and acid cells
2 Sub-mucous coat.
3 Blood vessels.
4 Circular and longitudinal muscular layers.
5 Fibrous tunic covered with peritoneum .. .60
h Small intestine, transverse section, showing villi, unicellular glands, mucosa, etc. ..... .95
i Section of Spleen ..... .75
j Adipose tissue ..... .60
k Connective tissue ..... .60
l Heart muscle, double stained, showing cross striations, nuclei, and characteristic branching of cardiac muscle cells ..... .60
m Voluntary muscles, double stained, showing cross striations, nuclei sarcolemma, etc. ..... .60
n Involuntary muscle, teased preparation, showing isolated muscle cells with nuclei ..... .75
o Nerve Cells, from Cerebrum, showing protoplasmic processes and nuclei $0.60
Cartilage, hyaline ..... .60
Spinal Cord, transverse section ..... .60
r Large Intestine, double stained ..... .70
s Sciatic Nerve, transverse section showing axis-cylinder, medullary substance, supporting connective tissue, etc. ..... .60
t Scalp, section of, showing hair, follicles, and sebaceous glands ..... .85
u Skin, section of, showing sweat glands ..... .85
v Lung, section of ..... .60
w Liver, section of, with blood vessels injected with red gelatin ..... .70
x Kidney, section of, injected ..... .70
y Retina of Eye, showing coats ..... .95

6024 Complete Set, as listed above 15.00

BOTANY

6026 Knott's Prepared Microscope Mounts for Botany:

a Longitudinal section of root tip of onion, showing
1 Root Cap.
2 Cell division and various karyokinetic nuclear stages $0.80
b Longitudinal section through apical cell of Nitella 1.00
c Cell formation by budding ..... .60
d Spirogyra showing
1 Protoplasm and nucleus.
2 Chlorophyll bands ..... .80
e Spirogyra in conjunction ..... .70
f Spores of Corn Smut ..... .60
g Mucor (black mould of bread) ..... .60
h Section through archegonium of moss ..... .95
i Section through antheridium of moss ..... .95
j Peristome of moss (Polytricum) ..... .60
k Prothallium of fern (Polypodium) showing
1 Reproductive organs.
2 Chlorophyll bodies ..... .75
l Section through archegonium of fern prothallium 1.20
m Prothallium with young fern attached 1.00
n Transverse section of rhizome of fern (Pteris) showing
1 Closed concentric fibro-vascular bundles.
2 Scalariform vessels.
3 Parenchyma.
4 Parenchymatous sclerenchyma.
5 Prosenchymatous sclerenchyma ..... .70
o Longitudinal section of n, showing 1, 2, 3, 4, 5, in longitudinal view ..... .70
p Sporangia and Spores of Fern ..... .60
q Longitudinal tangential section of wood of Pine showing cut ends of Medullary Rays ..... .60
r Longitudinal Radial section of wood of Pine showing
1 Pitted tracheids.
2 Medullary rays ..... .60
s Transverse section of vine stem showing first year's growth and arrangement of fibro-vascular bundles ..... .60
t Transverse section of wood of Pine ..... .60
u Epidermis of leaf showing stomata ..... .60
v Transverse section of leaf of Trillium ..... .60
w Transverse section of ovary of Trillium ..... .60
x Transverse section of stem of Indian Corn showing
1 Conjoint, collateral, closed vascular bundles
2 Parenchyma.
3 Sclerenchyma ..... .95
y Transverse section of exogenous stem showing
1 Cortex
2 Camnium
3 Rings of growth.
4 Pith
5 Medullary rays ..... .60

6027 Complete Set, as listed above 15.00

SPECIAL MICROSCOPIC SLIDES

These slides are very valuable in indicating a wider range of structures than the previous sets. They will be found especially valuable to all teachers who are using or intend to use **THE NATIONAL BIOLOGY NOTE-BOOK.** To assist such teachers the numbers of the sheets in the note-book, in which slides are particularly useful, are indicated at the right.

6030 BOTANY.

a	Spirogyra in Conjugation (B30)	$0.90
b	Conceptacles of Fucus (F10)	.90
c	Section of Cotyledon showing starch grains (F20)	.60
d	Section of Wheat (F21)	.90
e	Section of Oats (F21)	.90
f	Section of Nut (F21)	.90
g	Section of Pine (F21)	.90
h	Root-tip of Barley (F30)	.80
i	Root-tip of Dandelion (F30)	.80
j	Leaf-bud of Sycamore (F40)	.80
k	Flower-bud of Wallflower (F40)	.80
l	Flower-bud of Lily (F40)	.80
m	Section through Anther showing pollen chambers (low power) (F60)	.80
n	Varieties of Stamens showing methods of dehiscence (low power) (F60)	1.20
o	Different types of Pollen Grains (low power) (F60)	.80
p	Cross-section of Simple Ovary showing ovules (low power) (F60)	.80
q	Sections of Compound Ovary showing types of placentæ (low power) (F60)	1.20

6032 BACTERIA SLIDES

a	Diplococcus (Y20)	
b	Staphylococcus (Y20)	
c	Streptococcus (Y20)	
d	Bacillus (Tetanus with spores, an excellent type form) (Y20)	
e	Comma Bacillus (Y20)	
f	Streptobacillus (Y20)	
g	Streptothrix (Y20)	
	Complete Set	$8.50

6033 ZOOLOGY.

a	Paramœcium (R11)	$1.00
b	Paramœcium in Conjugation (R11)	2.50
c	Carchesium, double stained (R11)	2.00
d	Mitosis in Protozoa (Opalina), beautiful slide with two large nuclei in mitosis, triple stained. One of the most admirable specimens for showing the metotic cell division (R11)	2.50
e	Hydra showing both reproductive organs (R11)	2.00
f	Hydra showing ovary and bud (R11)	2.50
g	Hydra showing bud (R11)	2.00
h	Slides showing mitosis in Spermary (R11)	2.50

We frequently have been requested to supply a series of slides particularly adapted to the requirements of schools which do not differentiate between the biological sciences. We offer, therefore, for those schools the following lists of slides selected as best adapted to a general biology course of Botany, Physiology and Zoology.

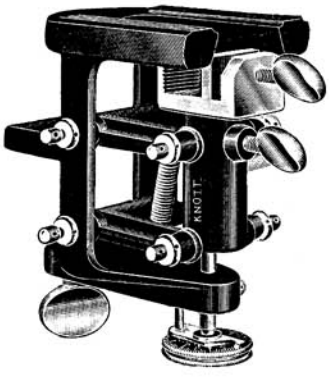
6035 GENERAL BIOLOGY COLLECTION, 40 microscopic slides selected to accompany a general course in Botany, Physiology and Zoology.

I	**ALGÆ:**		
	Chlorophyceæ (Green Algæ)		
	Conjugales		
	a Spirogyra; (Conjunction and zygospores), V. T. of glyc		$0.75
II	**FUNGI**		
	Phycomycetes		
	b Mucor (or Rhizopus), zygospores		.75
III	**MUSCI (MOSSES)**		
	c Funaria, small plants with rhizoids, whole		.60
IV	**FILICALES**		
	Leptosporangiatæ		
	d Pteris, T. S. and L. S. of the rhizone		.75
V	**GYMNOSPERMÆ** (Gymnosperms, cyads, conifers, etc.)		
	Coniferales		
	Pinaceæ		
	Abietineæ		
	e Pinus, L. S. of the staminate cone		.75
	f Pinus, cross section of the leaf		.60
	g Pinus, Ra., Ta., and Tr. sections of the wood		.75
VI	**ANGIOSPERMS**		
	Stems		
	Monocotyledones		
	h Zea Mays, L. S. and T. S. general stem structure with collat. bundles		.60
	Leaves		
	Sections showing structure		
	i Lilium pardalinum, T. S. (general structure)		.60
	The Flower		
	Stamens, anthers, pollen, male gametophytes		
	j Lilium, T. S. of anther		.75
VII	**PROTOZOA**		
	Rhizopoda		
	Lobosa		
	k Amœba, 1st class		1.20
VIII	**PORIFERA**		
	l Skeleton of Commercial Sponge		.60
IX	**CŒLENTERATA**		
	Hydrozoa		
	Leptolinæ		
	m Hydra, E		.90
	n Hydra, T. S		.75
X	**PLATYHELMINTHES**		
	Cestoda		
	o Tænia solium, proglottis, E		$0.75
XI	**NEMATHELMINTHES**		
	Nematoda		
	p Trichinella spiralis, in flesh		.75
XII	**ECHINODERMATA**		
	Echinoidea		
	q Echinus, pedicellaria		.60
XIII	**ANNULATA**		
	Chætopoda		
	Oligochæta		
	r Lumbricus, earthworm, T. S.		.60
XIV	**ARTHROPODA**		
	Insecta		
	Musca domestica (House Fly)		
	s Insect, proboscis		.90
	Lepidoptera		
	Bombyx (Silk Moth)		
	t Imago, scales		.60
	Coleoptera		
	Dytiscus marginalis (Water Beetle)		
	u Insect; trachea		.75
	v Insect; macilla and palpus		.75
XV	**CHORDATA**		
	Mammalia		
	Cat Tissue, D. S.		
	w Cerebrum		.75
	x Duodenum, T. S.		.75
	y Eye, retina		.75
	z Heart; cardiac muscle, striations, etc.		.60
	aa Liver		.75
	bb Lung; Alveolar structure, bronchi, etc.		.60
	cc Muscle, voluntary, T. S. and L. S.		.75
	dd Nerve Cells, multipolar		.75
	ee Nerve fibers, medullated (Sciatic Nerve		.75
	ff Pad of Toe		.75
	gg Stomach, T. S., Cardiac		.75
	hh Trachea, T. S.		.60
	Rabbit Tissues, D. S.		
	ii Kidney, T. S.		.75
	Ox Tissues		
	jj Ear; yellow elastic cartilage		.75
	kk Ligamentum nuchæ		.75
	HUMAN HISTOLOGY		
	ll Blood, leukæmia, D. S.		.60
	mm Scalp: white		.60
	nn Skin: white, sweat glands, etc.		.60

6036 Complete Set as listed above **$25.50**

6038 SLIDE MAKING MATERIAL. Teachers of Biology oftentimes have considerable difficulty in assembling material for mounting on slides. We have arranged for a careful selection of 50 packages of materials, diatoms, pollens, seed spores, parts of plants, insects, hairs, etc., prepared especially for mounting. Pet set of 50 packages **2.50**

No. 6040



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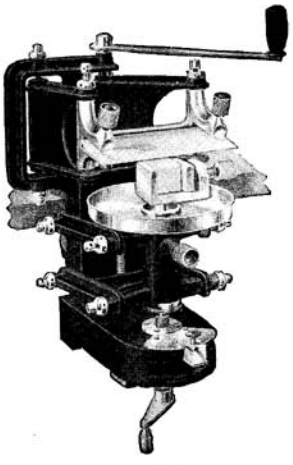


No. 6046

6040 MICROTOME, HAND. The object is placed in a clamp in the upper end of the tube and is raised through the hole in the glass plate by an accurately cut screw which is entirely enclosed from dust and injury. The feed is accurate and finely graduated, each division representing 10 microns. The plate at the top is 3 inches in diameter and makes a firm support for the knife..... **$10.00**

6042 MICROTOME, TABLE. Can be readily attached by a screw clamp to the laboratory table or other support. Object clamp sets in a vertically moving socket held as illustrated. Feed regulated by micrometer screw with graduated disc and index plate. Glass surface plates provide traveling ways which are extra long, so that the knife will not be drawn off from the ends. Without knife..... **18.00**

6043 ——, fitted with CO_2 Freezing Attachment No. 6069 ..... **31.50**

6044 ——, fitted with Ether Freezing Attachment No. 6067..... **27.00**

MICROTOME, AUTOMATIC LABORATORY, for attaching to the edge of the table. The upper part of the casting of which the table clamp is a part is designed as a frame which forms a support for the laterally swinging arms which carry the knife holder. By an ingenious method of mounting this holder, the knife is given a movement which utilizes the entire length of the cutting edge, thus insuring uniform wear and permitting the cutting of large sections. Absolute uniformity of thickness in all sections is insured.

Feed secured by a vertical feed screw with fine micrometer thread. This feed screw is keyed to an accurately cut ratchet wheel in the teeth of which a hardened steel pawl engages. This pawl may be thrown out or may be set to cut sections of any desired thickness. Each division of the graduated scale marks 5 microns.

The drop pan beneath the object clamp may be removed if desired (it will be found desirable to remove it when the freezing chamber is attached).

6046 MICROTOME, AUTOMATIC LABORATORY. Complete with one knife and object clamp for paraffine or celloidin. In case..... **$85.00**

6047 ——, fitted with CO_2 Freezing Attachment No. 6069 ..... **98.50**

6048 ——, fitted with Ether Freezing Attachment No. 6067..... **94.00**

No. 6050

ROTARY MICROTOME

New Construction

This microtome is the result of a most careful investigation of the requirements for a rotary microtome and a thorough study of the inaccuracies inherent in the earlier types. There are, in this new instrument, a number of points of advantage which will readily recommend themselves to the most exacting operator.

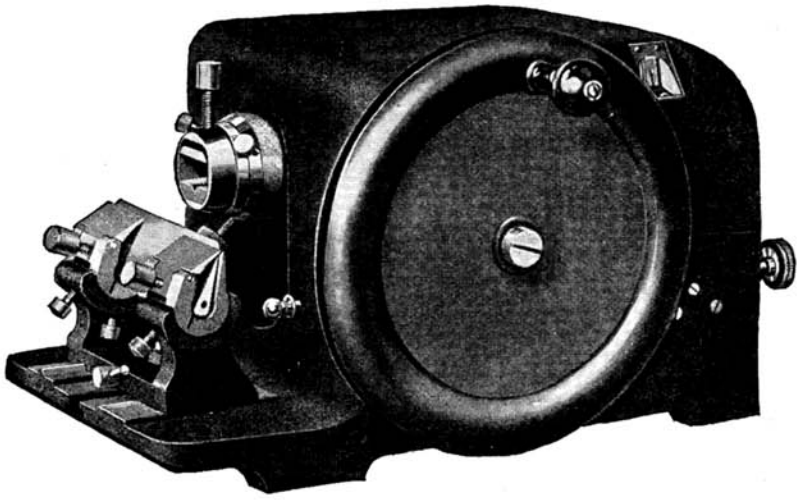
An accurate and reliable feed mechanism acting entirely independent of any inaccuracies due to the up-and-down movement of the object.

A modified escapement in connection with the ratchet wheel insures against momentum — a cause for inaccuracy in the older models.

The feeding is done when the object is above the knife.

Feed adjustment is convenient and definite and may be set for any thickness from 1 micron to 60 microns.

Continued on Next Page



No. 6050

No. 6050 Rotary Microtome **Continued from Preceding Page**

Total excursion of the feed is 37 mm. — double that of most microtomes.

The feed pawl is automatically raised above the teeth on the return stroke and feeding is automatically stopped when the feed nut has reached its limit.

The adjusting of the object to the knife can be done more delicately than on any other microtome.

The object clamp is absolutely rigid, of great capacity and is most easily and carefully oriented.

An up-and-down stroke of 50 mm. is possible — sufficient for cutting very large sections, also for cutting celloidin sections.

The knife may be attached at each end at the edge as well as at the back. These clamps may be moved towards one another to provide additional rigidity when desired and to permit using practically the whole of the cutting edge of the knife before resharpening.

The whole mechanism is covered dust-proof.

The microtome may be run by a motor.

With three object discs, one knife and handle and back for sharpening, all in case..... **$180.00**

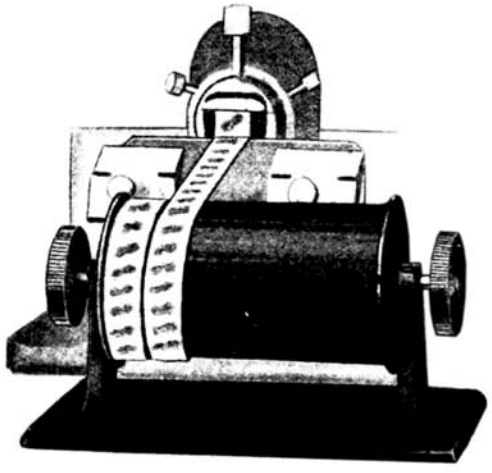
6050A KNIFE HOLDER for **celloidin** sections..... Extra **20.00**

6050B KNIFE for **paraffine sections**..... Extra **9.50**

6050C KNIFE for **celloidin sections.**
Extra..... **$9.50**

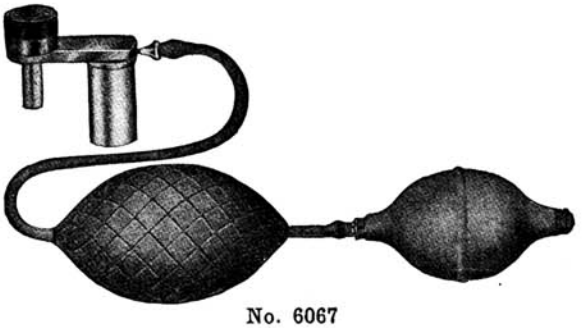
6051 MOTOR with enclosed speed regulator, mounted on neat microtome table 38×26 inches. For 110 volts.
Extra..... **100.00**

6053 RIBBON CARRIER, an aluminum cylinder, 4½ inches long by 2⅝ inches diameter. It is mounted in an aluminum frame work under the base of which are little rollers rolling in the direction of the long dimension of the frame. The end of the ribbon adheres to the cylinder, which in use is slowly turned by the buttons as the ribbon lengthens. At the same time the cylinder and frame are gently pushed forward on the rollers to place the ribbon on the cylinder in the long spiral..... **10.00**



No. 6053

MICROTOME ACCESSORIES



No. 6067

6067 MICROTOME FREEZING ATTACHMENT FOR ETHER. Consists of a freezing chamber of hard rubber which so prevents the radiation of the cold that the tissue is quickly frozen. The ether is held in a metal tank which for filling may be unscrewed from the support from which it is suspended. This attachment will freeze tissue 15 mm. in diameter and 3 mm. thick in one minute, using only 5 cubic cms. of ether **$9.00**

6069 MICROTOME FREEZING ATTACHMENT FOR CARBON DIOXIDE, for use on Microtomes **Nos. 6042** and **6046.** The freezing chamber is provided with a pin like that on the object clamp which fits into the same socket on the microtome. The chamber is connected with the CO_2 chamber by a flexible copper tube. With this freezing attachment it is possible to cut, stain and mount a section ready for examination in one and one-half minutes from the time the tissue is put in the chamber. Complete with copper tube connections **13.50**

Nos. 6073 to 6081 No. 6084

Microtome Knives. These knives are broad and heavy, steel most carefully selected, evenly tempered throughout their lengths. They are ground perfectly true so that when one is placed on an absolutely plane surface, the edge touches along its whole length, while the back does the same.

6073 MICROTOME KNIFE, 50 mm. cutting edge **$5.00**

6074 ——, 110 mm. cutting edge, used on Microtomes **6046** and **6050** **9.50**

6076 ——, 185 mm. cutting edge **14.50**

6078 ——, 250 mm. cutting edge **20.00**

6079 ——, 110 mm. cutting edge, ground especially for celloidin **9.50**

6081 ——, 150 mm. cutting edge, with handle **6.00**

6082 ——, special Wald make, 240 mm. cutting edge, curved metal shank **12.00**

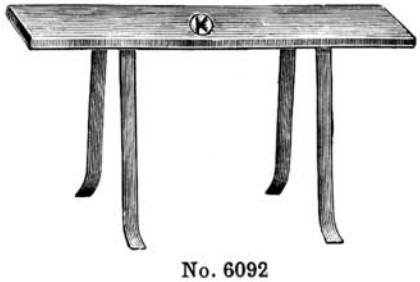
6084 MICROTOME KNIFE HANDLE for holding the knives while sharpening. Handles ebonized, metal parts finely nickel-plated **2.25**

6085 MICROTOME KNIFE BACK. In order that the knife may rest upon the honing stone at the proper angle when being sharpened, a special steel honing back has been designed. This slips over the back of the knife. **$1.75**

6088 MICROTOME KNIFE STROP, a flat piece of wood with a handle at one end. At one side of this strop is cemented a piece of leather 1¾ inches wide and 11 inches long, into which a very fine carborundum powder has been rubbed. The other side is covered by a very fine grade of leather for finishing **2.00**

6090 PITH for **cutting sections** ..... Per package **.25**

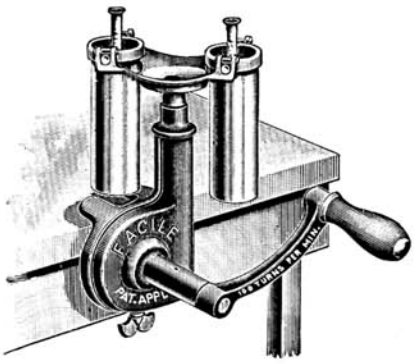
6092 WARMING TABLE for use in embedding objects in paraffine. Copper plate, 14×4 inches on stand 8½ inches high **2.40**



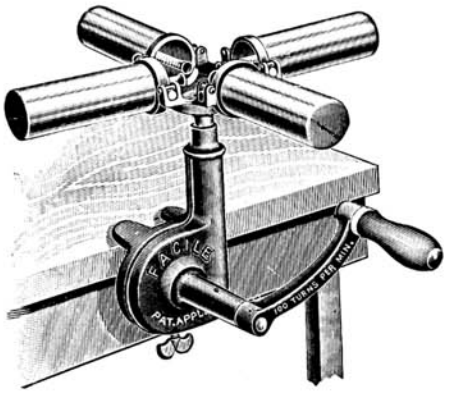
No. 6092

PARAFFINE BATHS. See **Baths, Paraffine.**

MILK TESTING APPARATUS



No. 6100



No. 6102

6100 **HAND DRIVE TWO-BOTTLE BABCOCK MILK TESTER.** Consists of but two castings forming the gear case united at a ground joint, forming an air-tight gear case. Drive secured by one large steel gear and the steel vertical spindle which has spiral teeth directly milled into it. Bottle carriers of heavily tinned malleable iron are removably attached to the top of the spindle. Rotating pockets are seamless brass.

Complete for milk testing, including test bottles, pipette, acid measure, test bottle brush, pint bottle of acid and full directions for making tests **$9.00**

6101 ——, with addition of cream test bottles, for making **both milk and cream tests** **10.00**

6102 **HAND DRIVE FOUR-BOTTLE BABCOCK MILK TESTER,** same as **No. 6100,** but with bottle carrier for four bottles and four seamless brass pockets.

Complete for milk testing with test bottles, pipette, acid measure, test bottle brush, pint bottle of acid, and full Wirections **10.00**

6103 ——, with addition of cream test bottles, for making **tests for both milk and cream** **11.00**

6105 **BABCOCK TEST TRAVELING OUTFIT.** Comprises **No. 6102** four-bottle Babcock milk tester, 3 Babcock full milk test bottles, 2 cream test bottles, 2 double-neck skim milk bottles, 1 pipette, graduated for both milk and cream, 1 test bottle brush, 1 acid measure, 1 small Quevenne lactometer, 1 glass thermometer, 1 bottle testing acid, all with full directions for making milk, cream and butter tests.

In hardwood carrying case with separate compartments for glassware and acid. Weight complete, 15¼ lbs. **18.00**

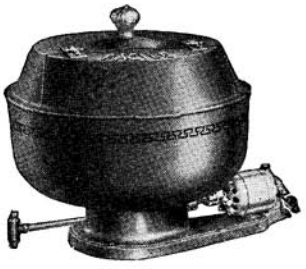
6107 **HAND DRIVE ENCLOSED BABCOCK MILK TESTERS for 6-inch long test bottles.** Bottle carriers are solid malleable iron castings heavily tinned, swinging pockets of seamless brass with tinned malleable hangers. Solid cast iron case is 16 inches in diameter; cover split and hinged. Rotation is secured through a pair of steel worm or spiral gears and a pair of steel spur gears which are mounted on a separate frame detachably secured to the under side of the body.

These machines turn with remarkable ease and run with that smoothness and freedom from jar that are required to make an accurate test.

Prices include milk test bottles, pipette, acid measure, test bottle brush, pint of acid and full directions, all securely packed.

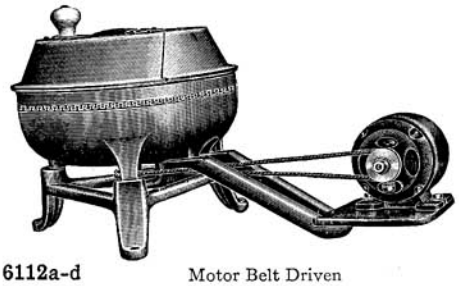
	a	b	c	d
No. of bottles	6	8	10	12
Complete	**$18.00**	**20.00**	**22.00**	**24.00**

No. 6107d



Electric Gear Driven

Nos. 6112a-d



Motor Belt Driven

6109 **MOTOR-DRIVEN TWO-BOTTLE BABCOCK MILK TESTER,** for **6-inch long test bottles.** This machine consists of a 1/30 H.P. vertical spindle electric motor which carries directly on the extended spindle the bottle carriers with swinging pockets.

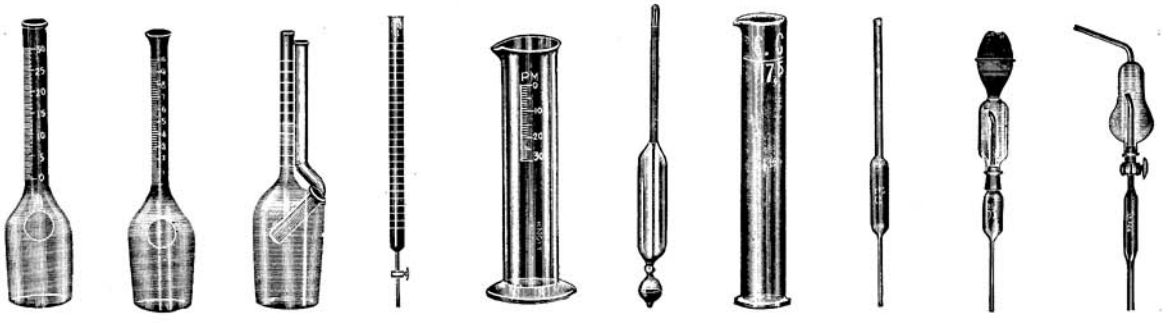
Complete with regular equipment of glassware and sundries as ordinarily supplied. (When ordering state whether for direct current or alternating current and voltage. If alternating current, state also the number of cycles and phases.) **$60.00**

6110 **MOTOR-DRIVEN FOUR-BOTTLE BABCOCK MILK TESTER,** same as above, but with **four bottle carriers** and necessary extra glassware and sundries **61.00**

6112 **MOTOR-DRIVEN ENCLOSED BABCOCK MILK TESTERS, direct connected, for 6-inch long test bottles.** In these machines the motor has a vertical shaft on which the bottle carrier is directly mounted. This brings the motor underneath the machine. In this construction the weight of the bottle carrier and its load of bottles is, of course, directly on the motor. The **motor belt driven style,** while not so compact, will be found the most desirable, all things considered.

When ordering, **specify style desired,** also **whether for alternating current or direct current circuits and voltage.** If alternating current, state number of cycles.

	a	b	c	d
No. of Bottles	6	8	10	12
Complete, Direct Connected Type or Motor-Belt Driven	**$65.00**	**66.00**	**67.50**	**69.00**



No. 6115 **No. 6123** **No. 6125** **No. 6130** **No. 6132** **No. 6136** **No. 6139** **No. 6141** **No. 6145** **No. 6147**

6115 **CREAM TEST BOTTLES, 6-inch, 9-gram,** 30 per cent. × ½ per cent. ..... Per dozen **$4.00**

6118 **CREAM TEST BOTTLES, 6-inch, 18-gram,** 30 per cent. × ½ per cent. ..... Per dozen **4.00**

6119 **——, 40 per cent. × ½ per cent.** ..... Per dozen **4.00**

6120 **——, 50 per cent. × ½ per cent.** ..... Per dozen **4.00**

6123 **MILK TEST BOTTLES, 6-inch, 18 gram,** 10 per cent. × 1/5 per cent. ..... Per dozen **4.00**

6125 **SKIM MILK TEST BOTTLE.** Gives readings down to one hundredth, each space representing five hundredths or 1/20 per cent. fat ..... **.80**

3803 **TEST BOTTLE BRUSH** for cleaning Babcock bottles ..... **.55**

6130 **ACID BURETTES** in 17.5 cc. divisions.

	a	b	c	d
No. of Charges	3	6	12	25
Each	**$2.75**	**3.50**	**4.00**	**5.00**

6132 **CREAMOMETER JAR,** 12×2 inches, graduated 0-30 and M or PM ..... **.95**

6134 **FUNNEL, ACID,** for filling milk and cream test bottles with acid ..... **.12**

6136 **LACTOMETER, SPENCE'S,** New York Board of Health pattern; 0° to 120° by 2° divisions **1.25**

6137 **LACTOMETER, QUEVENNE'S.** Scale 15° to 40° by single degrees. Sp. gr. Scale 1.015 to 1.040 .. **1.25**

6139 **ACID MEASURE,** 17.5 cc. ..... **.15**

6141 **ACID PIPETTE,** accurately graduated, 17.6 cc. ..... **.30**

6142 **——,** accurately graduated, 18 cc. ..... **.30**

6143 **——, with two marks,** 17.6 and 18 cc. ..... **.40**

6145 **AUTOMATIC PIPETTE.** To operate, squeeze rubber bulb, then insert point of pipette in milk, release bulb and the pipette fills, the overflow going into the large glass bulb **2.75**

6147 **IMPROVED PIPETTE.** By suction milk is drawn up until it is above the glass top, the stopcock is then closed and the measured milk is put in the test bottle **3.25**

6151 **CORROSIVE SUBLIMATE TABLETS** for preserving and coloring samples ..... Per 50 **.50**

6152 **FARRINGTON'S ALKALINE TABLETS** for determining the degree of acidity of milk, cream or whey ..... Per 50 **.50**

6155 **RICHMOND'S SLIDE RULE** for determining total solids in milk. With full directions for use **6.50**

MINERAL COLLECTIONS

6170 **WASHINGTON SCHOOL COLLECTION, 20 Minerals, 20 Rocks,** in clothboard case, printed label list on lid. . . . Per set **$6.00**

6171 **HARDNESS COLLECTION, 9 specimens,** each in tray, all in oak box. With small diamond Per set **4.25**

6172 **SPECIFIC GRAVITY COLLECTION, 25 specimens,** large size, in improved trays. . . . Per set **45.00**

6173 **LUSTER COLLECTION, 16 specimens,** large size, in improved trays. . . . Per set **17.50**

6174 **MISCELLANEOUS COLLECTION, 16 specimens,** selected especially to show play of colors, change of colors, opalescence, iridescence, tarnish, asterism, schillerization, fluorescence, phosphorescence. Large size specimens, in improved trays. . . . Per set **35.50**

6175 **FUSIBILITY COLLECTION, 6 specimens,** large size, in improved trays. . . . Per set **3.75**

6176 **COLLECTION ILLUSTRATING TASTE, ODOR AND FEEL, 20 specimens,** large size, in improved trays. . . . Per set **17.50**

6177 **BLOWPIPE COLLECTION, 50 most important species** each in tray, all in oak box . . . . Per set **6.00**

6178 **NEW YORK STATE PHYSICAL GEOGRAPHY COLLECTION, 64 specimens,** each in tray, all in pine box. . . . Per set **5.00**

6179 **COLLECTION OF SOILS, 20 specimens,** each in quarter-pint glass show bottle, then in improved trays. . . . Per set **15.00**

6180 **COLLECTION OF FUELS AND USEFUL HYDRO-CARBONS** (with **Associated Rocks and Fossils), 40 specimens,** extra large size, in improved trays. . . . Per set **27.50**

6181 **ORES OF GOLD, SILVER, PLATINUM AND IRIDIUM, 50 specimens,** each in tray, all in oak case. . . . Per set **60.00**

6182 **COPPER ORES AND MINERALS, 50 specimens,** each in tray, all in oak case. . . . Per set **15.00**

6183 **IRON ORES AND MINERALS, 50 specimens,** each in tray, all in oak case. . . . Per set **8.00**

6184 **ORES AND MINERALS OF THE LEAD AND ZINC GROUPS (Lead, Tin, Zinc, Cadmium and Mercury), 60 specimens,** each in tray, all in oak case . . . . Per set **18.00**

6185 **ORES AND MINERALS OF METALS USED FOR ALLOYING STEEL (Chromium, Cobalt, Manganese, Molybdenum, Nickel, Titanium, Tungsten and Vanadium), 50 specimens,** each in tray, all in oak case . . . . Per set **26.00**

6186 **ORES AND MINERALS OF THE ALUMINUM AND MAGNESIUM GROUPS. (Aluminum, Barium, Calcium, Magnesium and Strontium), 50 specimens,** each in tray, all in oak case. . . Per set **6.00**

6187 **ORES AND MINERALS OF THE ALKALI METALS (Cæsium, Lithium, Sodium, and Potassium), 25 specimens,** each in tray, all in oak case. . . . Per set **5.00**

6188 **ORES AND MINERALS OF THE NON-METALLIC AND SEMI-METALLIC ELEMENTS (Arsenic, Antimony, Bismuth, Boron, Carbon, Selenium, Silicon, Sulphur and Tellurium), 50 specimens** each in tray, all in oak case. . . . Per set **18.00**

6189 **ORES AND MINERALS CONTAINING THE RARE EARTH ELEMENTS (Beryllium, Cerium, Didymium, Erbium, Lanthanum, Niobium, Scandium, Tantalum, Thorium, Uranium, Yttrium, and Zirconium), 72 specimens,** each in tray, all in oak case . . . . Per set **40.00**

6190 **ROUGH PRECIOUS AND SEMI-PRECIOUS STONES, 25 specimens,** each in tray, all in oak case. . . . Per set **28.00**

6191 **MISCELLANEOUS NON-METALLIC ECONOMIC MINERALS, 50 specimens,** each in tray, all in oak case. . . . Per set **7.50**

MODELS—PHYSIOLOGICAL

ENLARGED SIZES — NATURAL COLORS

6200 **HUMAN HEART:** The anterior wall may be removed, exposing the four cavities of the heart, and their openings and valves. . . . **$17.50**

6201 **HUMAN EYE:** The upper portion, containing a microscopical representation of the layers of the retina, can be removed, when the cornea and the iris, the lens and the vitreous body may be taken out **12.50**

6202 **HUMAN EAR:** Separates into parts, showing the membrana tympani, the ossicles of the tympanum, the labyrinth and the half-opened cochlea. . . . **10.00**

6203 **HUMAN SKIN:** Transverse section, showing the organs of perspiration, a hair and its follicles, the pulp, sebaceous glands and tactile corpuscles. . . . **7.50**

6204 **HUMAN TEETH:** The anterior portion of the left maxillary bone is removed to show the development and structure of the teeth. . . . **8.00**

6205 **HUMAN BRAIN:** Four views:

a View of upper portion. . . . **6.50**

b View of lower portion (basis of cerebral nerves). . . . **6.50**

c View of perpendicular section along the median line. . . . **6.50**

d View of transverse section of the head, showing the cavities. . . . **6.50**

6206 **HUMAN HEAD:** Three Views:

a Head with muscles, nerves and blood vessels of one side. . . . **9.50**

b Cavities of skull and eye, upper and lower jaw. . . . **9.50**

c View of perpendicular section of the head, showing the brain, cavities of the mouth and nose, and the larynx and pharynx divided along the median line. . . . **9.50**

6207 **HUMAN LUNGS** with the heart in normal position:

a Anterior view of the lungs and heart. The pericardium opens and the anterior portion of the left lung may be removed, showing the bronchial ramifications, aveoli, etc. . . . **6.75**

b Posterior view of the lungs and heart, with a representation of the bronchial ramifications, air cells, blood vessels and lobuli **6.75**

6208 **ORGANS OF RESPIRATION, AIR PASSAGES, LUNGS AND HEART:** The anterior part of both lungs and heart removes, laying open the lungs and showing the ramifications of the windpipe, and the connection of the pulmonary blood vessels with the heart. . . . **19.50**

Continued on Next Page

PHYSIOLOGICAL MODELS — Continued

6209 **HUMAN LARYNX:** Anterior and posterior views:
- a Is an anterior aspect, showing base of tongue, hyoid bone, thyroid gland, etc **$4.75**
- b Posterior aspect, showing the glottis and vocal cords **4.75**
- c Larynx in connection with the tongue and pharynx, the latter is opened from behind, and parts showing mucous membrane **4.75**

6210 **HUMAN JOINTS:** Partially opened, showing their bones and ligaments:
- a Arm-joint of the shoulder, opened **6.00**
- b Elbow-joint, a, anterior view **4.50**
- c Elbow-joint, b, lateral view **4.50**
- d Wrist-joint and hand **6.00**
- e Hip-joint **6.00**
- f Knee-joint **6.00**
- g Ankle-joints and foot **6.00**

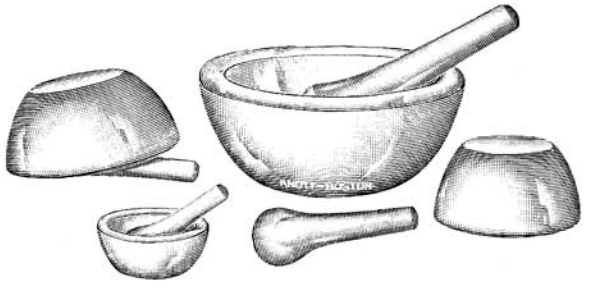
6211 **HUMAN TRUNK** (Torso), with viscera of the chest and abdomen laid open **42.00**

6212 **HUMAN SKULL AND BRAINS,** the various parts of which can be taken out **17.50**

6213 **LARYNX PHANTOM,** mask of the face with mouth open **13.00**

6215 **PHYSIOLOGICAL MODELS.** Set complete, 28 models as above listed **250.00**

No. 6222



No. 6224

6220 **MORTARS, PRESSED GLASS,** with pestles.

	a	b	c	d
Capacity, ounces	2	4	8	16
Diameter, inches	2¾	4	5	5¾
Each	**$0.45**	**.65**	**.80**	**1.35**

6222 **MORTARS AND PESTLES, IRON,** urn shape.

	a	b	c
Capacity, pints	1	2	4
Each	**$1.40**	**1.90**	**2.75**

6224 **MORTARS AND PESTLES, PORCELAIN,** with porcelain pestles.

	a	b	c	d
Diameter, inches	2¾	4½	5⅛	6¼
Each	**$0.46**	**1.20**	**1.80**	**3.40**

MOUNTING PAPER. **See Paper, Mounting,** page 281.

6235 **MUFFLES, FUSED SILICA.** (See index, **"Fused Silica Ware,"** for characteristics.) Highly refractory, will not crack with sudden and extreme changes of temperature, absolutely gas tight. For assaying, ash determinations, ignition of precipitates, and general analytical and chemical work, they are unequalled. Especially valuable for enamelling small work, hardening and annealing small parts and for general testing and experimental use.

	a	b	c	d	e	f
Length, outside, inches	4½	6½	9½	7⅛	9½	18¼
Width, outside, inches	2⅝	4⅜	5⅞	4¾	6⅛	6⅝
Height, inches	2⅜	3½	5	2¾	4½	5
Each	**$3.50**	**4.62**	**7.67**	**4.62**	**6.95**	**11.55**

MUSEUM JARS. See **Jars, Museum.**

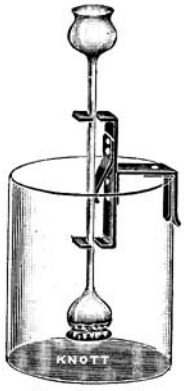
6245 **NEEDLE, INOCULATING,** platinum point sealed in glass handle **$0.80**

6945 **NESSLER'S JARS OR TUBES** for ammonia tests in water analyses.

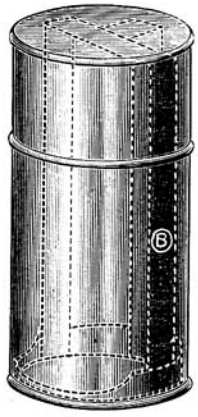
	a	b	c
Graduated, cc.	50	100	50 & 100
Each	**$0.75**	**.90**	**1.10**

No. 6255

No. 6256



No. 20–215



No. 6295

6248 **OIL STONE,** high grade, an excellent stone for scalpels **$0.75**

6255 **OIL TESTER, Cleveland Open Fire Tester,** for high grade lubricating oils. Made of very heavy copper and brass casting, nickel-plated **15.00**

6256 **OIL TESTER, ELLIOT'S, POLISHED COPPER** for **flash-point determinations,** adopted as standard by the States of New York, New Jersey, Iowa, Michigan, and in general use everywhere..... **15.50**

20–215 **OSMOSIS APPARATUS, STUDENTS',** for qualitative as well as quantitative work in osmosis. The apparatus consists of an osmosis tube of design illustrated, held adjustably in a nickel-plated clamp which may be clamped to the side of a jar. One end of the osmosis tube is closed by a thin porous membrane which may be removed and replaced from time to time as needed.
Apparatus complete as illustrated **2.50**

6268 **OVERSLEEVES,** chemical and water-proof, ample in size, readily adjusted to both sexes....Per pair **.50**

5134 **PANS, AGATE WARE.**

	a	b	c
Dimensions, inches	6⅛×1½	7×1⅝	8½×2
Capacity, quarts	½	1	2
Each	**$0.35**	**.45**	**.60**

6280 **PAPER, SAND.**

	a	b	c
	Fine	Medium	Medium Coarse
Per dozen sheets	**$0.30**	**.35**	**.45**

PAPER, FILTER. See **Filter Paper.**

6285 **PAPER, GLAZED,** for use in laboratory, in color reactions.

	a	b	c
Color	White	Black	Blue
Per quire	**$1.00**	**1.00**	**1.00**

5780 **PAPER, LITMUS, red,** in sheets.....Per sheet **$0.10** Per quire **$0.75**

5781 **PAPER, LITMUS, red,** in books of strips.....Per book **.10**

5782 **PAPER, LITMUS, blue,** in sheets.....Per sheet **.10** Per quire **.75**

5783 **PAPER, LITMUS, blue,** in books of strips.....Per book **.10**

6290 **PAPER, PARCHMENT,** best grade of vegetable parchment .....Per sheet **.15**

6990 **PAPER, TUMERIC** .....Per book **$0.10** Per sheet **.10** Per quire **.75**

6291 **PENCIL, DIAMOND,** for etching on glass and marking on metal. Made from a good-sized diamond. Will be found unusually handy in laboratory or tool room. (For illustration see page 230)..... **3.50**

6292 **PENCIL, INDELIBLE,** for marking glass utensils ..... **.25**

5789 **PENCIL, LITMUS** ..... **.35**

6295 **PETRI DISH HOLDER, POLISHED COPPER,** with **inside tray** to **lift out.** Size 9 inches high by 4½ inches diameter **4.75**

6297 **PHOTOSYNTHESIS APPARATUS.** (See National Biology Direction Sheets, Exp. F53)..... **2.25**

PINCHCOCKS. See **Clamps.**

6300 **PINS, INSECT, special, double japanned black,** finely tempered steel, needle points, absolutely fast heads.

	a	b	c	d	e	f	g	h	i
Size No.	00	0	1	2	3	4	5	6	7
Per 100	**$0.40**	**.40**	**.40**	**.40**	**.40**	**.40**	**.40**	**.40**	**.40**

6301 **PINS, INSECT, special, double plated white steel pins,** finely tempered steel, needle points, absolutely fast heads.

	a	b	c	d	e	f	g	h	i
Size No.	00	0	1	2	3	4	5	6	7
Per 100	**$0.50**	**.50**	**.50**	**.50**	**.50**	**.50**	**.50**	**.50**	**.50**

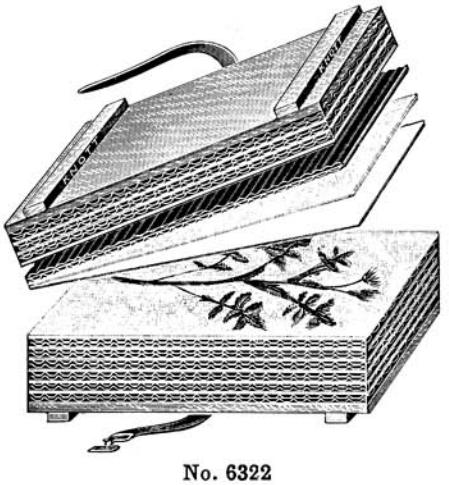
6302 **PINS, INSECT,** with **yellow heads, japanned steel pins,** needle points, absolutely fast heads.

	a	b	c	d	e	f	g	h	i
Size No.	00	0	1	2	3	4	5	6	7
Per 100	**$0.40**	**.40**	**.40**	**.40**	**.40**	**.40**	**.40**	**.40**	**.40**

6305 **PIPES, CLAY**.....Per dozen **$0.50**

No. 6308

No. 6309



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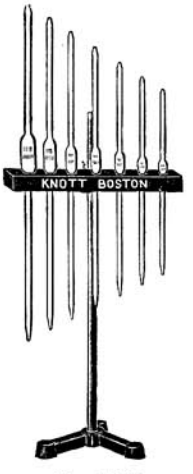


No. 6314

No. 6317

6308 **PIPETTES, Medicine Droppers,** straight tubes with pure rubber bulbs. Per dozen **$0.50**

6309 ——, **bent tubes** with pure rubber bulbs. Per dozen **.50**

6312 **PIPETTES, MOHR'S,** accurately graduated.

No. 6312 No. 6313

	a	b	bb	c	e	f
Capacity, cc.	1×1/100	2×1/10	5×1/10	10×1/10	25×1/10	50×1/10
Each	**$0.45**	**.30**	**.40**	**.50**	**.85**	**1.20**

6313 **PIPETTES, VOLUMETRIC,** accurately graduated with one mark.

	a	b	c	d	e	f	g	h	i	j	k
Capacity, cc.	1	2	3	5	10	15	20	25	50	75	100
Each	**$0.20**	**.20**	**.20**	**.20**	**.25**	**.33**	**.35**	**.40**	**.55**	**.60**	**.70**

6314 **PIPETTES, VOLUMETRIC WITH STAND,** a set of above pipettes, 1, 2, 5, 10, 25, 50 and 100 cc., with improved stand. Set **5.50**

6317 **PIPETTE, OVERFLOW, AUTOMATIC,** with patent three way stopcock and reservoir for collecting the excess liquid. Capacity 25 cubic centimeters **4.75**

6318 ——, **capacity 100 cubic centimeters** **6.25**

6090 **PITH** for **cutting sections** Per package **.25**

6322 **PLANT PRESS.** This press is a simple contrivance by which a plant is dried in a few hours without the troublesome changing of blotters and shifting of specimens. Consists of a series of layers of tubular paper inserted between sheets of blotting paper and absorbent cotton so that all the moisture is carried off by a current of hot air passing through the tubes. Size 9×12 inches **3.00**

6322A ——, **size 12×19 inches** **5.00**

6323 **MOUNTING PAPER,** 11×17 inches. Per quire **.75**

6324 **DRYING PAPER,** 11×17 inches. Per quire **.65**

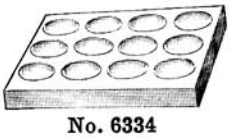
6325 **GENUS COVERS** for mounting specimens; 11½×17½ inches when folded. Per quire **1.25**

6327 **PLATES, FILTER, ALUNDUM,** for filtering where a small amount of solid matter is present in a large amount of liquid. May also be used for filtering dust from air or flue gases. Porosity 43.9 per cent. carried in stock. (Porosity 47.4 per cent. may also be obtained on application.) 60° bevelled edge.

	a	b	c	d
Inches	¾×1/16	1×1/16	2×3/32	3×⅛
Each	**$0.45**	**.50**	**.56**	**.67**

6330 **PLATES, GLASS** for covers of bottles, beakers, etc.

	a	b	c
Size, inches	4×4	5×5	6×6
Each	**$0.05**	**.07**	**.09**



No. 6334

6332 **PLATES, GLASS, blue cobalt glass.** 2×4 inches. **$0.25**

6332a ——, 4×4 inches. **.35**

6334 **PLATE, PORCELAIN, glazed,** 11×9 centimeters, with twelve cavities for color reactions. **.93**

6337 **PLATE, STREAK, unglazed porcelain,** 6½×5 cms., for arsenic test, etc. **.30**

6339 **PLATES, PORCELAIN, porous, square,** for drying crystals and precipitates. 10 mm. thick, size 6×6 inches. **.50**

6342 **PLATES, PERFORATED GLAZED PORCELAIN,** for use in funnels.

	a	b	c
Diameter, mm.	25	38	50
Each	**$0.27**	**.40**	**.50**

6345 **PLATES, FUSED SILICA, UNGLAZED.** (See index, "**Fused Silica Ware**" for characteristics.)

	a	b	c
Thickness, inch	1/10–⅛	3/16	¼
Per square inch	**$0.07**	**.10**	**.12**

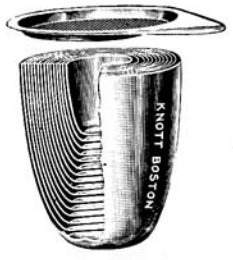
6346 **PLATES, FUSED SILICA, GLAZED,** 1/16–⅛ inch thick, in plates up to 6 inches square. Per square inch **.24**

PLATINUM WARE

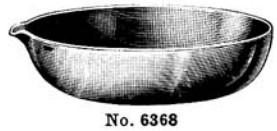
All of the following ware is hammered to shape, tested and finished in the best manner. It is guaranteed free from flaws and blisters and to give entire satisfaction in competent hands. Approximate weights are given without price. **Prices will be governed by the market price of platinum.**

Nos. **6364**a-e

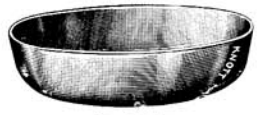
Nos. **6361**a-g



Nos. **6363**a-k

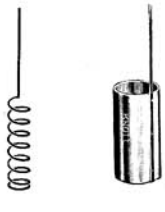


No. **6368**



No. **6371**

No. **6381**



No. **6355** No. **6357**

No. **6380**

No. **6369**

No. **6373**

No. **6370**

No. **6375**

6350 PLATINUM FOIL.

	Light	Medium	Heavy
Thickness, inch	.001	.002	.0035
Thickness, mm.	.03	.05	.09
Approximate weight per square inch.	0.353	0.705	1.058

6352 PLATINUM WIRE. Platinum loops for chemical laboratory work are usually made of No. 28 wire, platinum triangles of Nos. 24 or 26, platinum inoculating needles of No. 24 and sometimes of No. 20.

B. & S. Gauge No.	18	20	22	24	25	26	28	30	32
Diameter, inch	.0403	.0319	.0253	.0201	.0179	.0159	.0126	.01	.0079
Diameter, mm.		.81	.64	.51	.45	.40	.32	.26	.20
Weight per foot, grams.	5.365	3.404	2.081	1.330	1.077	0.851	0.480	0.332	0.213

6355 PLATINUM ANODE, spiral $\frac{5}{8}$ inch in diameter, made of .040 inch wire, $6\frac{1}{2}$ turns, weight approximately 7 grams. This is the standard form and designed particularly for use with Cathode **No. 6357** following.

6357 PLATINUM CATHODE, diameter of cylinder 1 inch, height 2 inches, height of stem 2 inches, height over all 4 inches. Diameter of stem .040 inch. Approximate weight 11 grams.

6361 PLATINUM FILTER CONES, seamless, 60°, perforations .016 to .025 inch.

	a	b	c	d	e	f	g
Diameter, inches	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2
Approx. weight, grams	1	1.5	2.1	3.1	5.3	7.5	9.2

6363 PLATINUM CRUCIBLES WITH COVERS. A crucible with cover weighs approximately as many grams as it holds cubic centimeters.

	a	b	c	d	e	f	g	h	i	j	k
Diameter, cms.	2.2	2.5	3.0	3.3	3.5	4.0	4.2	4.4	4.7	5.0	5.3
Depth, cms.	2.2	2.5	3.0	3.3	3.5	4.0	4.2	4.4	4.7	5.0	5.3
Capacity, cc.	8	10	15	20	25	30	40	50	60	70	80
Approx. weight, grams	8	10	15	20	25	30	40	50	62	65	68

6364 PLATINUM CRUCIBLES, GOOCH, WITH COVERS.

	a	b	c	d	e
Diameter, cm.	2.7	3.2	3.3	3.6	3.9
Depth, cms.	2.7	3.2	3.3	3.6	3.9
Capacity, cc.	10	15	20	25	30
Approx. weight, grams	13	18	22	29	37

6366 PLATINUM DISHES, round bottom, with lip.

	a	b	c	d	e	f	g	h	i	j	k	
Diameter, cms.	3.8	4.2	4.4	4.8	5.6	6.5	6.5	7.2	7.8	8.4	8.9	9.4
Depth, cms.	1.0	2.0	2.2	2.4	2.7	3.0	3.3	3.5	3.7	3.7	4.1	4.3
Capacity, cc.	15	20	25	35	50	65	75	100	125	150	175	200
Approx. weight, grams	5	6	8	12	17	22	25	33	42	50	55	67

6367 PLATINUM DISHES, without lip, a to l, same sizes and weights as above.

6368 PLATINUM DISH for **iron, steel or water analysis,** capacity 45 cc., approximate weight 15 grams.

6369 PLATINUM DISH for **milk analysis,** capacity 45 cc., approximate weight 17 grams.

6370 PLATINUM DISH for **sugar analysis,** capacity 35 cc., approximate weight 16 grams.

6371 PLATINUM DISH for **water analysis,** capacity 100 cc., approximate weight 20 grams.

6373 PLATINUM TIPPED FORCEPS for **blowpipe work** and general laboratory use.

6375 PLATINUM INCINERATING DISHES.

	a	b
Capacity, cc.	15	20
Approx. weight, grams	10	14

6377 PLATINUM SPATULAS.

	a	b
Length, cms.	7	10
Approx. weight, grams	5	8

6379 PLATINUM TRIANGLES, solid ends.

	a	b	c	d	e	f
For crucible, capacity cc.	10	15	20	30	40	60
Size of wire, inch	.045	.045	.055	.055	.064	.064
Weight in grams	5	8	11	12	15	18

6380 PLATINUM TRIANGLES, twisted ends.

	a	b	c	d	e	f
For crucible, capacity cc.	10	15	20	30	40	60
Size of wire, inch	.045	.045	.055	.055	.064	.064
Weight in grams	5	6	11	12	18	20

6381 PLATINUM TRIANGLES WITH HOLDERS, holders nickel-plated and will accommodate any size triangle for holding crucible up to 100 cc.

	a	b	c	d	e	f	g	h
For crucible, capacity cc.	10	15	20	30	40	60	80	100
Size of wire, inch	.047	.047	.050	.050	.062	.062	.064	.064
Weight in grams	2	2.5	4.5	5	7.5	8	9	10

No. 6385

6385 **PLIERS, SIDE CUTTING,** good quality.....Each **$0.85**

PNEUMATIC TROUGHS. See **Troughs, Pneumatic.**

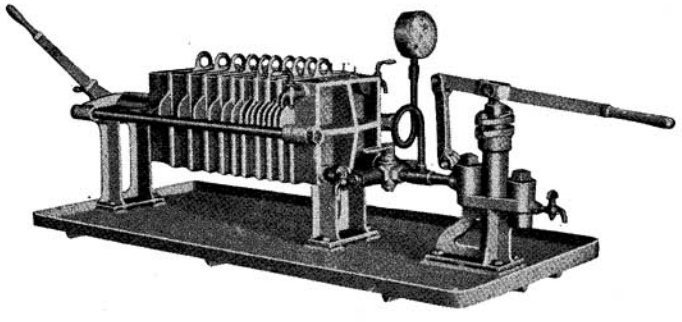
POROUS CUPS.	**91–15b**	**91–92**	**91–167**	**91–77**
Diameter, inches	1½	2	2½	3
Height, inches	3	4	5	7
Each	**$0.30**	**.35**	**.45**	**.55**

POTASH APPARATUS. See **Bulbs, Potash.**

PRESSES FOR CORKS. See **Cork Presses.**

PRESSES FOR PLANTS. See **Plant Presses.**

No. 6391



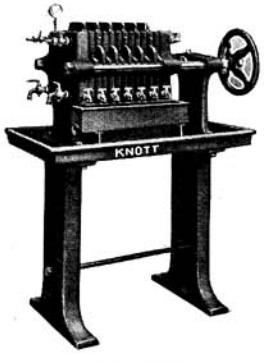
No. 6388

6388 **PRESS, LABORATORY FILTER, Iron,** closed delivery washing type. This press is 7 inches square outside, makes cakes 6 inches square, and contains the following units — four plates, four ½-inch frames, two 1-inch frames, two 1½-inch frames, and two 2-inch frames.
The filtering area of this press is 72 square inches per chamber, and the greatest filtering area using four ½-inch chambers, is 2 square feet. The holding capacity can be varied from 18 cubic inches using one ½-inch frame, to 252 cubic inches using two 1½-inch frames and two 2-inch frames.
The press is of the four-eyed closed delivery washing type and is equipped with a direct connected hand pump, press and pump mounted on a pan.
Without Filter Cloth or Paper..... **$150.00**

6388A **FILTER CLOTHS** for above.....Each **.25**

6388B **FILTER PAPER** for above.....Per lb. **1.00**

6390 **PRESS, LABORATORY FILTER, Iron,** for filtering oils, soap, extracts, sugar, etc. This is by far the most complete laboratory filter press built along lines of a commercial machine.
There are five plates, each plate so proportioned that the combined filtering area of the two sides is one square foot. There are six 1-inch frames in the press, giving a capacity of ¼-cubic foot.
Plates and frames are easily arranged for plain, simple or thorough washing with or without separate discharge for wash. The filtrate can be caused to flow out by cocks or through one head cock, the latter being called "closed discharge."
Material is fed into the press by means of the Montejus **No. 6391** or by a steam or hand pump.
The press is made of cast iron with a substantial cast iron table provided with a drain.
Without Filter Cloth or Paper..... **135.00**

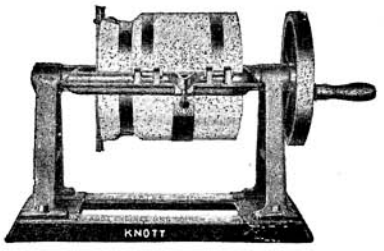


No. 6390

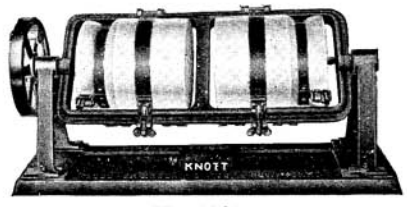
6390A **FILTER CLOTHS** for above.....Each **.25**

6390B **FILTER PAPER** for above.....Per lb. **1.00**

6391 **MONTEJUS.** Material can be fed into the Filter Press **No. 6390** by means of a Montejus. The material to be filtered is placed in the Montejus and air pressure applied above the mixture (use our **No. 42–76** Air Pump). The pipe running to the filter press extends nearly to the bottom of the Montejus and the mixture is thus displaced through it into the filter press. Complete as illustrated..... **55.75**



No. 6395



No. 6396

6395 **PULVERIZER or CRUSHER, One-jar Ball Mill,** hand or power, for reducing to powder cement, coal, lime, and any material, hard or soft. Widely used in assay, cement, gas and soils laboratories. Porcelain jar, capacity 1⅛ gallons; pulley 9×1 inch. Equipped with handle for hand drive, and complete with pebbles **$35.00**

6396 ——, **Two-jar Ball Mill,** similar to above, but two jars mounted on same axis, giving double the capacity of **No. 6395** **65.00**

PYROMETERS

INDICATING METERS — THERMO-COUPLES

A Pyrometer of two essential parts — the **Meter** which indicates or records the temperature and the **Thermo-Couple** which, on being placed in the heat to be measured, generates the electromotive force that actuates the meter. We have listed below two different types of meters each of which can be obtained with different ranges and graduated in Fahrenheit or Centigrade divisions. We have also listed various types of thermo-couples. From among these listed it will be possible to select types and ranges suited to individual requirements. To insure getting the proper outfit, it is advisable to inform us in regard to the service for which it is to be used.

Nos. 6397 to 6400C

PORTABLE INDICATING METERS. These are the highest grade D'Arsonval type Milli-voltmeters designed especially for pyrometer work. They are very sensitive high-torque meters, provided with:

1 **Zero Temperature Adjustment** which insures meter indicating correctly regardless of the temperature of the surrounding media.

2 **Zero Adjustor** which is a simple device for setting the pointer to agree with the cold end temperature of the Thermo-couple.

3 **Resilient Pivot Mounting** which permits the utmost delicacy in adjustment of the movement, and by protecting it from the effects of jars and vibrations, preserves its accuracy.

The case is of aluminum, finished in black enamel. Over all dimensions are 6¼×6×3 inches. Scales are 5½ inches.

The **Low Resistance Meter** can be used when the resistance of the lead wires is not over ½ ohm. This is the resistance offered by 100 feet of No. 14, or 150 feet of No. 12, or 250 feet of No. 10 copper wire. Generally speaking, if the lead wires are to be more than 200 feet, the **High Resistance Meter** must be used. High Resistance Meters are equipped with both milli-volt and temperature scales and they also carry a mirror.

6397 **LOW RESISTANCE PORTABLE METER,** range 32-1000° F., 10 degrees per division **$66.65**

6397A ——, range 0-550° C., 5 degrees per division **66.65**

6397B **HIGH RESISTANCE PORTABLE METER,** range 32-1000° F., 10 degrees per division **83.35**

6397C ——, range 0-550° C., 5 degrees per division **83.35**

6398 **LOW RESISTANCE PORTABLE METER,** 32-1500° F., 20 degrees per division **66.65**

6398A ——, 0-800° C., 10 degrees per division **66.65**

6398B **HIGH RESISTANCE PORTABLE METER,** 32-1500° F., 10 degrees per division **83.35**

6398C ——, 0-800° C., 10 degrees per division **83.35**

6399 **LOW RESISTANCE PORTABLE METER,** 32-2000° F., 20 degrees per division **66.65**

6399A ——, 0-1100° C., 10 degrees per division **66.65**

6399B **HIGH RESISTANCE PORTABLE METER,** 32-2000° F., 20 degrees per division **83.35**

6399C ——, 0-1100° C., 10 degrees per division **83.35**

6400 **LOW RESISTANCE PORTABLE METER,** 32-2500° F., 25 degrees per division **66.65**

6400A ——, 0-1400° C., 20 degrees per division **66.65**

6400B **HIGH RESISTANCE PORTABLE METER,** 32-2500° F., 20 degrees per division **83.35**

6400C ——, 0-1400° C., 10 degrees per division **83.35**

Nos. 6402 to 6405A

WALL INDICATING METERS. Low Resistance Type. These meters are essentially the same as the Portable Meters above listed, except that they are designed with wall mounting. The cases are of aluminum, finished in black enamel. Diameter, 6 inches, depth 3½ inches. Scale arc, 5½ inches.

FAHRENHEIT SCALES			CENTIGRADE SCALES		
Catalogue No.	Range	Degrees per Division	Catalogue No.	Range	Degrees per Division
6402	32–1000	10	**6402A**	0–550	5
6403	32–1500	20	**6403A**	0–800	10
6404	32–2000	20	**6404A**	0–1100	10
6405	32–2500	25	**6405A**	0–1400	20

Price, with any of the above standard scales **$66.65**

WALL INDICATING METERS, High Resistance Type. Prices on Application.

6407 THERMO-COUPLES. "CHROMEL," Low Resistance. These thermo-couples generate an electro-motive force five times greater than the costly platinum-rhodium couples, have a practically straight line temperature — E.M.F. relation, are heavy in cross section and are inexpensive. No. 14 B. & S. Gauge elements; length of couple 3 feet. Price includes handle and 10 feet of flexible leads.

For maximum temperature of 1000° F. (550° C.) **8.35**

6408 ——, for maximum temperature of 1500° F. (800° C.) **8.35**

6409 ——, for maximum temperature of 2000° F. (1100° C.) **8.35**

For **Extra Length Couples** add . . . . . Per foot **.55**

6410 THERMO-COUPLES, "CHROMEL," same as above, but No. 8 B. & S. Gauge elements and with flexible leads 20 feet long.

For maximum temperature of 1000° F. (550° C.) **9.45**

6411 ——, for maximum temperature of 1500° F. (800° C.) **9.45**

6412 ——, for maximum temperature of 2000° F. (1100° C.) **9.45**

6413 ——, for maximum temperature of 2500° F. (1400° C.) **9.45**

For **Extra Length Couples** add . . . . . Per foot **.85**

6414 THERMO-COUPLES, "CHROMEL," same as **No. 6407** but No. 6 B. & S. Gauge elements and with flexible leads 20 feet long.

For maximum temperature of 2000° F. (1100° C.) **11.15**

6415 ——, for maximum temperature of 2500° F. (1400° C.) **11.15**

For **Extra Length Couples** add . . . . . Per foot **1.40**

THERMO-COUPLES, High Resistance Type. Prices on Application.

6420 PYROMETER TUBES, ALUNDUM. (See index, **"Alundum Ware,"** for characteristics.) Supplied in lengths of 8, 12, 18, 24, 27, 30, 36, 39, 42 and 48 inches. When ordering **specify catalogue number,** length, bore, and wall.

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**
Bore, inch	7/16	3/16	1/4	9/16	3/4	7/8	1	1 1/8
Wall, inch	1/8	5/32	1/8	3/16	1/4	1/4	1/4	7/16
Per inch	**$0.33**	**.33**	**.33**	**.45**	**.45**	**.55**	**.55**	**.55**

6425 RECALESCENT OUTFIT — a simple and reliable apparatus for determining the proper hardening temperatures of carbon steel (high carbon steels only). The apparatus consists of an **Electric Furnace** without controlling rheostat and a Pyrometer with Thermo-Couple.

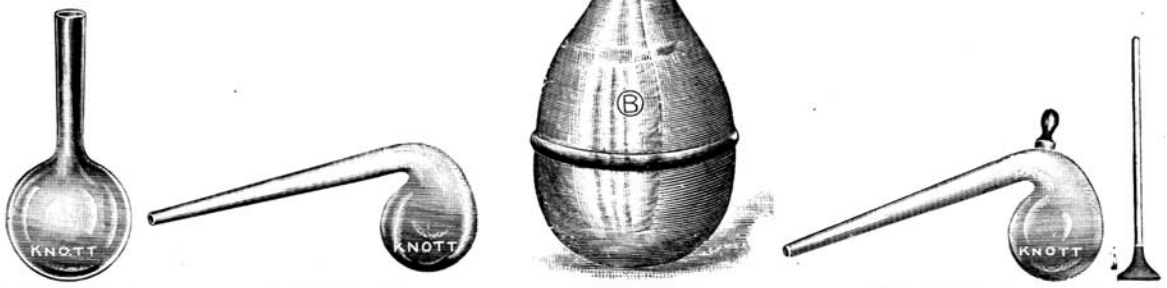
The operation is to clamp two small pieces of steel to the end of the thermo-couple, place them in the electric furnace and heat until the "recalescent" or "critical" point is passed as indicated by the pyrometer.

Outfit complete with Electric Furnace **No. 5482A** (see page 246), for 110 or 220 volts alternating current (60 cycles) or direct current **$106.10**

Note. When ordering specify line voltage and whether alternating or direct current.

No. 6425

PYKNOMETERS. See **Bottles, Specific Gravity.**



Nos. 6435 a-c Nos. 6445 a-c Nos. 6440 a-d Nos. 6446 a-f No. 6490

6435 RECEIVERS, RETORT.

	a	b	c
Capacity, ounces	4	8	16
Each	$0.40	.50	.60

6440 RETORTS, COPPER, for generation of oxygen, etc.

	a	b	c	d
Capacity, ounces	8	16	32	64
Each	$3.00	3.50	4.25	5.70

6445 ——, GLASS, plain, without tubulatures and glass stoppers.

	a	b	c
Capacity, ounces	8	16	32
Each	$1.10	1.25	1.65

6445½ ——, "PYREX" GLASS (see index, **"Pyrex" Glassware** for characteristics). With tubulature for rubber stoppers, but without ground-glass stoppers.

	a	b	c
Capacity, cc.	125	250	500
Each	$1.80	2.25	3.35

6446 ——, GLASS with **glass stoppers** ground in.

	a	b	c	d	e	f
Capacity, ounces	4	8	16	32	48	64
Each	$1.50	1.60	1.80	2.20	3.50	4.00

6446½ ——, "PYREX" GLASS (see index, **"Pyrex" Glassware** for characteristics). With tubulatures fitted with ground-glass stoppers.

	a	b	c
Capacity, cc.	125	250	500
Each	$2.90	3.35	4.45

6448 ——, IRON, for distilling mercury, etc.

	a	b	c
Capacity, ounces	8	16	32
Each	$4.50	5.00	5.50

RINGS FOR RING STANDS. See page 297.

6480 RODS, GLASS, in lengths of one meter.

	a	b	c	d
Diameter, mm.	4	5	6	7
Per pound	$0.50	.50	.50	.50

6482 RODS, STIRRING, fire-polished ends.

	a	b	c	d
Size, inches	3/16×6	1/4×6	3/16×8	1/4×10
Per dozen	$0.45	.55	.55	.80

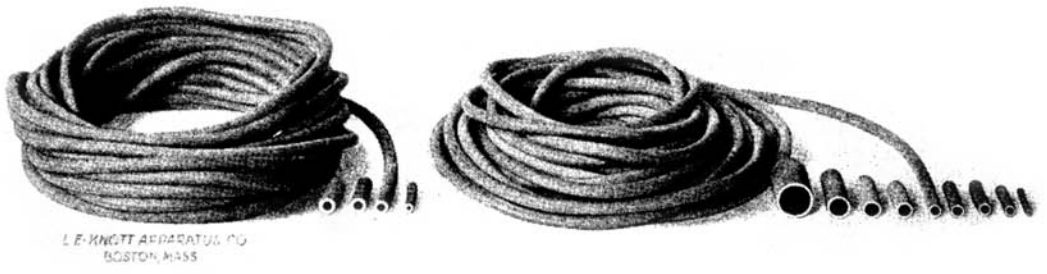
6484 ——, FUSED SILICA (see index, **"Fused Silica Ware,"** for characteristics.) Can be used for stirring and pouring at high temperatures, particularly in the case of high melting metals and alloys which do not form basic oxides. **In lengths up to 3 feet**

	a	b	c	d	e	f
Diameter, inch	1/16	1/8	3/16	1/4	5/16	3/8
Per foot	$0.55	.72	1.10	1.50	1.73	2.00

6486 RUBBER BANDS, assorted sizes. Per box **$0.20**

6490 RUBBER POLICEMEN for scraping precipitates from the sides of beakers, etc. For use on glass rods. Pure rubber, without glass rod. Each **.15**

THE KNOTT QUALITY
ANTIMONY RUBBER TUBING AND STOPPERS



Many laboratories have not yet appreciated the fact that cheap rubber is, in the end, the more expensive. Both economy and efficiency in laboratory organization make it eminently desirable to use the best rubber obtainable. In ordering, specify Knott's " 317 " Antimony Rubber, and thus be sure of obtaining a rubber of the highest quality.

6500 **KNOTT'S " 317 " ANTIMONY RUBBER TUBING,** regular thickness of wall, extraordinary quality.

Inside diameter, inch	1/8	3/16	1/4	5/16	3/8	1/2	3/4
Price per foot	$0.06	.09	.12	.15	.21	.35	.75

6501 ——, in lots of not less than 50 feet . . . . . Per lb. **$3.50**

6502 **KNOTT'S " 317 " ANTIMONY RUBBER TUBING,** same quality as above, but extra thickness to withstand pressures.

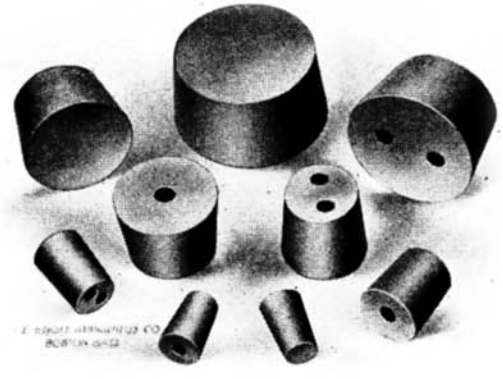
Inside diameter, inch	1/8	3/16	1/4	5/16
Price per foot	$0.10	.16	.22	.30

6503 ——, in lots of not less than 50 feet . . . . . Per lb. **3.50**

3830 **RUBBER TUBING STRETCHER.** One of the most serviceable tools for the laboratory (see illustration page 212) . . . . . **.75**

6510 **FLEXIBLE STEEL GAS TUBING,** for gas supply, connections to hot plates, gas stoves, gas burners, etc. This tubing is practically indestructible, is gas tight and will not kink. Inside diameter ¼-inch, and carried in stock in two and three-foot lengths only, each length with rubber ends for connecting to gas cock and burner nipples.

	a	b
Length, feet	2	3
Per length	$0.25	.35



KNOTT'S " 317 " ANTIMONY RUBBER STOPPERS
No. 6515

In order to simplify the method of determining the size of rubber stopper desired for a specific purpose, our stoppers are given a number corresponding to the small diameter in millimeters. Hence, the stopper K25 means a stopper 25 millimeters in diameter.

In ordering specify the number according to our list and insist on Formula " 317 " if you wish a stopper of the very highest grade.

We carry in stock rubber stoppers, solid, and with one hole and with two holes as indicated below.

Size No.	Diameter Small End mm.	Mean Diameter mm.	Length mm.		Price Per 100
K11	11	12	22	solid or 1 hole	**$4.00**
K13	13	15	22	solid or 1 hole	**5.00**
K15	15	17	25	solid, 1 or 2 holes	**6.00**
K17	17	19	25	solid, 1 or 2 holes	**7.00**
K19	19	21	25	solid, 1 or 2 holes	**8.00**
K21	21	23	25	solid, 1 or 2 holes	**10.00**
K23	23	25	30	solid, 1 or 2 holes	**13.00**
K25	25	28	30	solid, 1 or 2 holes	**16.00**
K28	28	30	30	solid, 1 or 2 holes	**$18.00**
K30	30	33	30	solid, 1 or 2 holes	**22.00**
K33	33	37	28	solid, 1 or 2 holes	**25.00**
K37	37	41	28	solid, 1 or 2 holes	**33.00**
K40	40	44	30	solid, 1 or 2 holes	**44.00**
K43	43	46	32	solid only	**50.00**
K47	47	50	32	solid only	**55.00**
K51	51	53	32	solid only	**60.00**

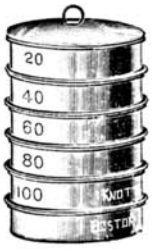
Special Quantity Prices Upon Request.

Cork Stoppers. See page 226.

No. 6520

No. 6522

No. 6923



No. 6532

No. 6531

No. 6533

No. 6524

No. 6526

6923 **SACCHAROMETER, DR. EINHORN'S FERMENTATION,** with graduated test tube..... **$1.10**

6520 **SCISSORS,** of **general utility,** fine grade..... **1.25**

6522 **SCOOP, HORN**..... **.25**

6524 **SHEARS, METAL CUTTING,** superior quality. Cutting blade 2½ inches..... **3.00**

6526 **SHEARS, PAPER,** superior quality. Cutting blade 10 inches long..... **2.50**

6530 **SIEVES, SEAMLESS BRASS FRAMES, BRASS GAUZE,** substantially constructed for mixing or separating substances into different grades of fineness. These sieves are made so that one will nest with the other. Five inches diameter.

	a	b	c	d	e	f
Mesh.....	10	20	40	60	80	100
Each.....	**$1.75**	**1.80**	**2.00**	**2.25**	**2.35**	**2.50**

6531 **SIEVES, SEAMLESS, BRASS FRAMES, BRASS GAUZE,** same as above but 8 inches diameter.

	a	b	c	d	e	f
Mesh.....	10	20	40	60	80	100
Each.....	**$3.00**	**3.10**	**3.25**	**3.50**	**3.75**	**4.00**

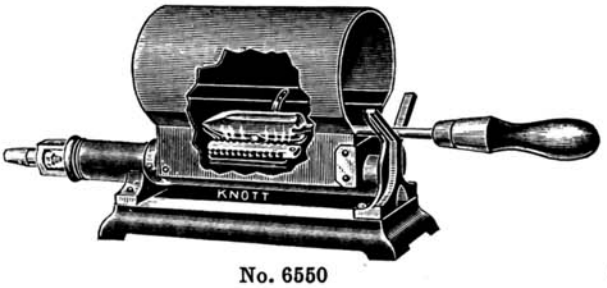
6532 **SIEVES, SEAMLESS, BRASS FRAMES, BRASS GAUZE, nested,** 5 inches in diameter, 20, 40, 60, 80 and 100 mesh, with brass pan and cover. Same sieves as **Nos. 6530b-f**.....Per set of five **13.00**

6533 ——, 8 inches in diameter, 20, 40, 60, 80 and 100 mesh, with brass pan and cover. Same sieves as **Nos. 6531b-f**.....Per set of five **18.50**

6535 **SIEVES, WOOD FRAME, BRASS GAUZE,** diameter 6 inches

	a	b	c	d
Mesh.....	30	40	60	80
Each.....	**$1.00**	**1.10**	**1.25**	**1.75**

No. 6542



No. 6550

32-200 **SIPHON, GLASS,** plain..... **.45**

32-205 **SIPHON WITH SUCTION TUBE,** glass..... **.75**

32-210 **SIPHON, AUTOMATIC,** simple demonstration form..... **.60**

SLEEVES. See **Oversleeves.**

6542 **SOLDERING OUTFIT.** Comprises one bar of solder, one box of resin, scraper and a special soldering copper of sufficient size to retain heat and designed so that it may either be heated as an ordinary soldering copper, or, when attached to a gas burner, the gas will pass through a hollow tube within the length of the handle and is ignited at emission holes immediately beneath the copper. In wooden box..... **2.25**

6543 **SOLDERING OUTFIT,** similar to above, except that the soldering copper is not adapted to a gas burner and is not quite so highly finished. In wood box..... **2.00**

6544 **SOLDERING COPPER,** with handle, one-half pound size..... **.75**

6545 **SOLDER, stick form**.....Per lb. **.50**

6546 **SOLDER, Wire Form** with **Resin Cutter.** No flux required.....Per lb. **2.00**

6547 **SOLDERING PASTE, ACID**.....Box **.35**

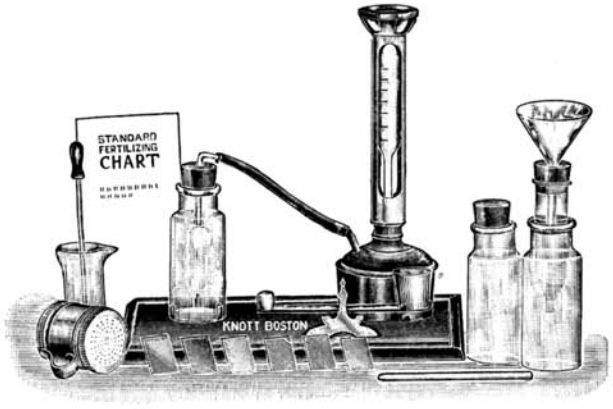
6548 **SOLDERING FLUID, ACID**.....Bottle **.45**

SOLDERING IRON, ELECTRIC. See **Electric Appliances.**

6550 **SOLDERING IRON HEATER,** for coal gas, a necessity for the laboratory work room..... **2.75**

6551 ——, same as above for gasoline gas..... **3.75**

SOXHLET'S APPARATUS. See **Extraction Apparatus.**



No. 6538

6538 SOIL TESTER. A simple equipment by which any one without a knowledge of chemistry can accurately gauge the resources and values of land. A quantitative test for lime, humus, acidity and phosphates in soils. With this outfit one can accurately show (1) whether the soil is in the right chemical and physical condition; (2) different degrees of acidity; (3) how much lime is needed per acre to counteract the acidity; (4) what quantity carbonates (lime and magnesia) is contained in a soil; (5) whether a soil lacks humus; (6) whether a soil is in need of a green manure crop; (7) whether a soil will respond to artificial inoculation with commercial bacteria cultures, etc. This is a practical outfit which any one without special skill or training can operate.
Without chemicals which can be found in any chemical laboratory or can be obtained from the local druggist, but otherwise complete as illustrated. With full instructions for use **$17.50**

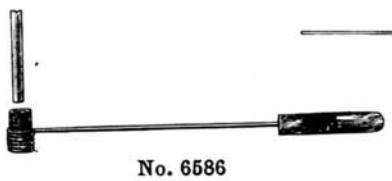
No. 6560

No. 6562

No. 6564

No. 6578

Nos. 6574 and 6576



No. 6586

Nos. 6580a-c

Nos. 6582a-c

6560 SPATULAS, HORN, double.

	a	b	c
Length, inches	4	5	6
Each	$0.30	.40	.50

6562 SPATULA, RUBBER, OSTWALD'S. This is a superior instrument and will be found practically indestructible ..... .45

6564 SPATULAS, STEEL with **wood handle.** Flexible polished steel blade.

	a	b	c
Length, inches	3	4	6
Each	$0.40	.45	.60

6570 SPLINTS, 100 in package, selected lengths ..... Per package .30

6572 SPONGES for general laboratory use. These sponges are of excellent quality, selected of convenient size and to give long service ..... Each .18

6574 SPOONS, DEFLAGRATING, of **heavy iron,** handles 16 inches long.

	a	b
Diameter of spoons, inch	½	¾
Each	$0.12	.16

6576 SPOONS, DEFLAGRATING, of heavy brass, handles 16 inches long.

	a	b
Diameter of spoons, inch	½	¾
Each	$0.18	.20

6578 SPOON, HORN, with **Spatula End,** length 5 inches ..... .50

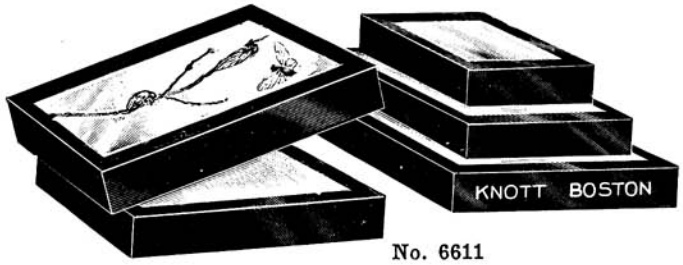
6580 SPOONS, PORCELAIN, with **Spatula End, glazed.**

	a	b	c
Length, mm	120	160	190
Each	$0.33	.67	.80

6582 SPATULAS, PORCELAIN, with Spatula on each end, glazed.

	a	b	c
Length, mm	105	120	150
Each	$0.33	.46	.55

6586 SPOON, SODIUM, Sodium Capsule, after Brownlee and others. With ramrod ..... .75



No. 6611

6610 SPECIMEN MOUNTS, KNOTT'S PROTECTED BOTANICAL. Consist of two parts — a thin plate of photographic glass to which narrow flaps of linen morocco paper are neatly fastened, and a cardboard back to which is glued a thin layer of sterilized surgical cotton in which the specimens may be embedded.

	a	b	c	d
Size, inches	5×6	6½×8½	8×12	12×16
Each	$0.40	.45	.70	1.35

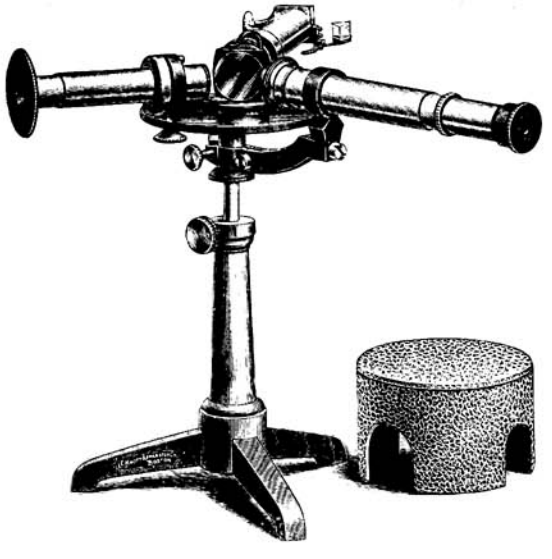
6611 SPECIMEN MOUNTS, KNOTT'S PROTECTED ENTOMOLOGY, suitable for mounting and preserving specimens of butterflies, beetles and insects of all kinds, or of plants too large for botanical mounts. Consist of two parts — the mounting part a heavy cardboard tray lined with a heavy pad of cotton, and the cover, designed to fit dust-proof over the mounting part, is fitted with a photographic glass top which allows inspection of specimens. This cover portion is covered with black binding cloth.

	a	b	c	d	e	f	g	h
Size, inches	2½×3	3½×4½	4×5	5×6	6½×6½	6½×8½	8×12	12×16
Each	$0.25	.32	.36	.45	.55	.60	.80	1.50

SPECIMENS

Unless otherwise stated these specimens are preserved in Formalin.

6620a	**Amoeba** (Microscopic Slide, special preparation)	Each	$1.25
6620b	**Grantia** (Simple Sponge)	Dozen	1.00
6620c	**Hydra** (Fusca or Viridis)	Dozen	2.50
6620d	**Metridium** (Sea-anemone), medium size	Dozen	5.00
6620e	**Medusa of Obelia** (slide, stained) (shows medusa structure)	Each	1.25
6620f	**Medusa** (Gonionemus), small	Dozen	2.50
6620g	**Medusa** (Aurelia), large	Dozen	6.00
6620h	**Coral Species**	Dozen	$2.00
6620i	**Earthworm** (Lumbricus)	Dozen	1.25
6620j	**Sandworm** (Nereis Virens)	Dozen	2.50
6620k	**Starfish** (Asterias Forbesis), medium, dry	Dozen	2.50
6620kk	**Starfish** (Asterias Forbesis), medium, formalin	Dozen	3.00
6620l	**Sea Urchin**	Dozen	2.50
6620m	**Crayfish** (Cambarus)	Dozen	3.00
6620o	**Florida Grasshoppers,** large	Dozen	2.75
6620v	**Amphioxus**	Dozen	3.50
6620w	**Necturus**	Dozen	20.00
6620x	**Frogs** (large)	Dozen	5.00
6620y	**Frogs** (medium)	Dozen	3.50



No. 77–170

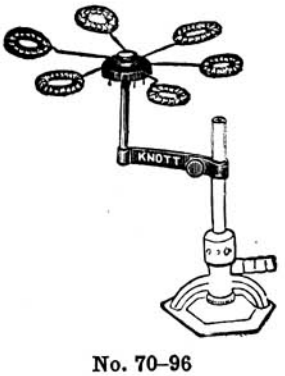
77–170 ADVANCED SPECTROSCOPE. This instrument is especially designed for high school and elementary college work. It is furnished completely equipped with all essential parts.

All mechanical details are well constructed and nicely fitted; all optical parts are of the best. The telescope is adjustable, has an aperture of about 20 mm. and a focal length of about 160 mm. The collimator is provided with a comparison prism and is of the same dimensions as the telescope. A separate tube contains the scale. The instrument is mounted adjustably in a neatly finished tripod stand. It is furnished with a 60-degree flint glass prism and provided with a cover for same **75.00**

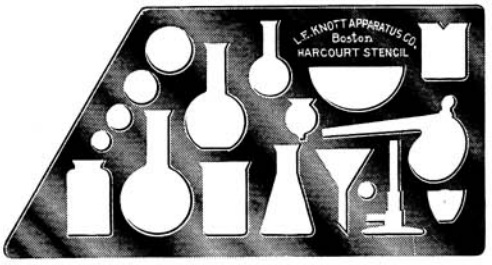
70–96 MONOCHROMATIC FLAME ATTACHMENT FOR BUNSEN BURNER. Can be attached in an instant to any Bunsen burner as illustrated. The absorbent ring sponges are saturated with solutions of various salts — sodium, potassium, lithium, etc. The swiveled head can be turned to obtain the flame desired.

Without burner **$3.75**

70–97 MONOCHROMATIC FLAME ATTACHMENT FOR BUNSEN BURNER, Single Flame Type. Consists of an absorbent ring sponge attached to a wire which is fastened to a simple spring clamp for clamping to the burner tube. One or more may be clamped to the burner tube at one time and the various wires bent to bring the ring sponge in position as desired **1.50**



No. 70–96

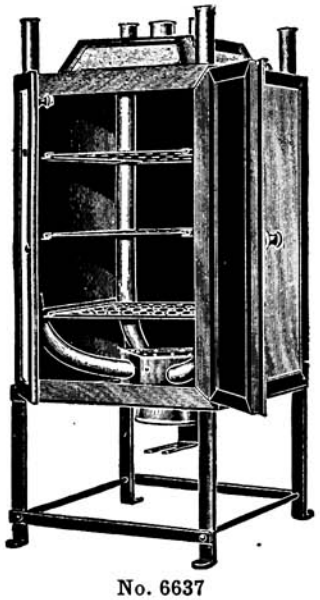


No. 6630

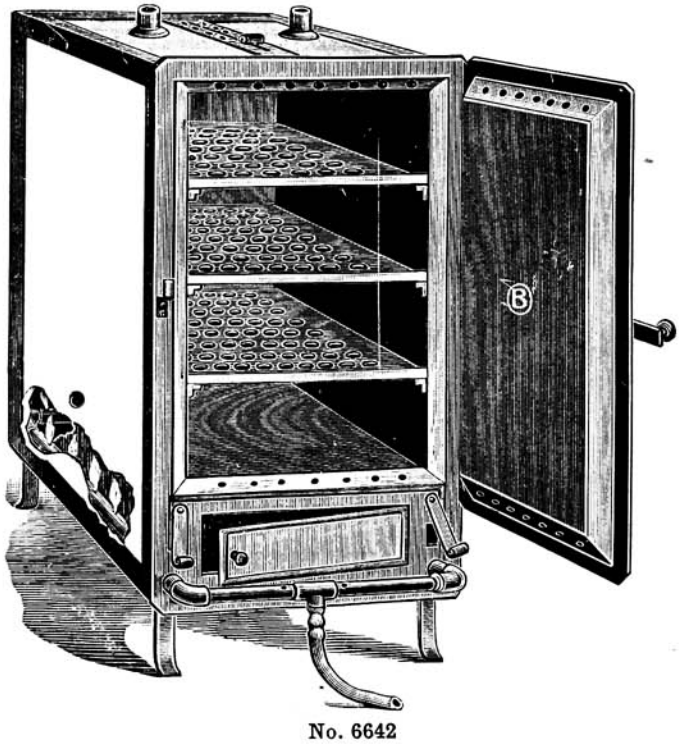
6630 STENCIL, HARCOURT IMPROVED. Consists of a flexible transparent plate with "cut-outs" representing outlines of various chemical utensils as illustrated. The ruling edges of the obtuse angle serve as convenient guides in drawing delivery tubes. One edge has a metric scale for dimensions. Recommended by prominent teachers of chemistry in that its use eliminates bad drawings, saves time, inspires the pupil, holds his attention and induces accurate thinking. . Each **$0.15**
Per dozen **1.70**

6631 STENCIL CUT-OUTS, three sizes Flat Bottom Flasks, Erlenmeyer Flask, Bottle, Plain Beaker, Griffin Beaker, Thistle Top, Funnel, Evaporating Dish, Bunsen Burner, Crucible and Retort. Of transparent material, same shapes and sizes as cut-outs of stencil illustrated above. Per package of 13 cut-outs . . . . . **.05**

STERILIZERS



No. 6637



No. 6642

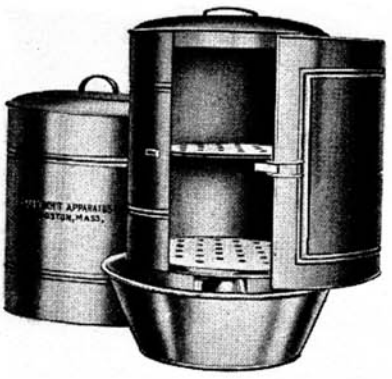
6637 STERILIZER, HOT AIR, of galvanized American Ingot Iron, single wall, has tubes extending from the bottom through the oven, passing up the four corners, insuring proper, even circulation of heat. Inside dimensions, 8×8 inches by 12 inches high **$65.00**

6637A ——, inside dimensions, 10×10 inches by 16 inches high **70.00**

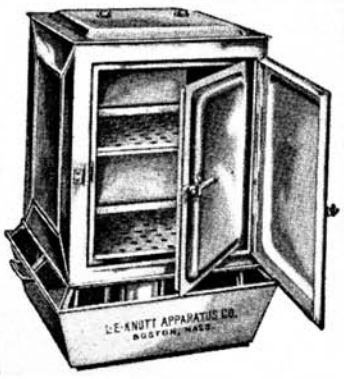
6637B ——, inside dimensions, 12×12 inches, by 18 inches high **77.50**

6640 STERILIZER, HOT AIR, of **sheet iron, double wall** with enclosed base and extra asbestos mat. Inside measurements, 10 inches high, 12 inches wide and 10 inches deep. Extreme height, including base, 21½ inches. With two shelves **28.00**

6642 STERILIZER, HOT AIR, of **sheet iron, double wall,** outer wall **covered with asbestos.** Heated by a row of small Bunsen Burners around the sides of the base, insuring an even circulation of heat. The air is introduced through openings on each side. Inside dimensions, 19 inches high, 12 inches wide, 9½ inches deep. With three shelves **51.00**

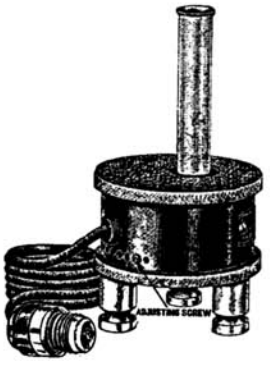


No. 6647



No. 6648

No. 6649B



No. 6649A

6647 **ARNOLD STEAM STERILIZER,** side door pattern with two removable perforated discs. Made of heavy tin with copper bottom; 7⅛ inches high × 8½ inches diameter..... **$14.75**

6647A ——, same as above, but 11¾ inches high by 10⅛ inches in diameter..... **19.00**

6647C ——, same as **No. 6647** but made entirely of copper, 11¾ inches high by 10⅛ inches in diameter..... **47.00**

6648 **BOSTON BOARD OF HEALTH STEAM STERILIZER.** Made entirely of copper with double walls and doors so that the sterilizing chamber is surrounded on all sides by a jacket of steam. An unvarying temperature of 100 degrees Centigrade can be maintained. Inside measurements,—height, 14¾ inches; width, 8¾ inches; depth, 9 inches. With two removable wire cloth trays.... **$87.50**

6648A ——, same as above, but sterilizing chamber measures inside, 15¼×12¼×12¼ inches..... **95.50**

6649 **STERILIZER, DRY AIR, ELECTRIC.** This apparatus consists of the **Electric Test Tube Boiler No. 6649A** and the **Sterilizer Attachment No. 6649B.** For either direct current or alternating current 110 or 220 volt circuits.

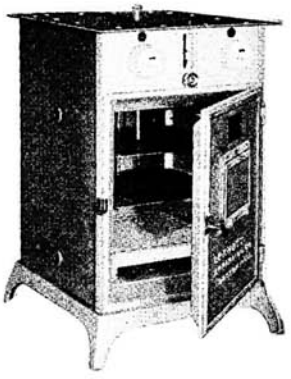
When ordering specify voltage..... **30.60**

6649A **ELECTRIC TEST TUBE BOILER** as used in above outfit. This boiler or heater consists of a cylindrical drum 2⅜×3½ inches diameter, having a nickel-plated metal body with a top and bottom of ¼-inch transite. Near the center of the drum is the heating receptacle, $1\frac{1}{16}$ inch diameter by 1⅜ inch deep. This receptacle is encased in a heating unit controlled by an automatic Electro-Thermo-Regulator, contained within the drum. Adapter rings are provided for the receptacle, permitting the use of ½, ⅝, ¾ and 1 inch test tubes.

With test tubes, small crucible, connector plug and cord for either direct current or alternating current 110 or 220 volt circuits.

When ordering specify voltage..... **22.25**

6649B **STERILIZER ATTACHMENT** for use with **No. 6649A Test Tube Boiler.** Dimensions 3⅛ inch diameter by ⅞ inch deep. A wire basket is contained within the sterilizer and may be removed by an adjustable wire tray. Constructed of metal, nickel-plated..... **8.35**



No. 6650

6650 FREAS' CONSTANT TEMPERATURE DRY STERILIZER. The general construction, regulation and heating of this sterilizer is identical with that of the Freas' Incubators listed on page 259, the only difference being that the sterilizer is graduated for temperatures up to 175° C. and, accordingly, provided with a heating plate wound for 600 watts. Each sterilizer is provided with two switches — one for the current, the other for the lamp illuminating the chamber. Size of chamber 12×12×12 inches. Iron base to stand on table **$150.00**

6650A ——, size of chamber, 14×17×18 inches, on heavy base with legs as illustrated over **No. 5696A,** page 259 ..... **294.50**

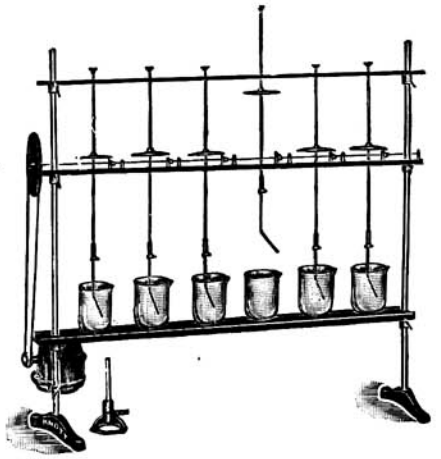
The sterilizers above do not have an inner glass door. All sizes may be obtained with removable glass doors and with a spare low wattage heating plate for incubating and other purposes up to 70° C. Such additions permit the use of the sterilizers as **Incubators** or **Chemical Drying Ovens.**

6655 THE INSTITUTE MULTIPLE SPEED STIRRING APPARATUS, Six Stirrers. The friction drive principle has been most satisfactorily employed in this design. The main drive shaft runs horizontally and has six friction drive discs which can be adjusted along the drive shaft to obtain the same speed of rotation for all the stirrers, or any speed desired for the individual stirrers. The revolution of one or more stirrers can be stopped instantly without interfering with the remaining stirrers, by raising the individual drive shafts so that the drive wheels are not in contact with the friction drive discs.

To remove a beaker, raise the individual drive shaft as shown in the illustration. Ample clearance is provided, thus avoiding all danger of spilling the liquid in the beaker.

The beaker support is designed to hold beakers of any capacity up to 1000 cc. It is made of channel iron and asbestos with openings in the metal to permit more ready heating of the contents of the beaker when such heating is desired. These openings are covered with metal gauze held between the channel iron and the asbestos plate.

The stirring apparatus can be operated by hand power, electric or water motor. As ordinarily supplied, a 110-volt, 60-cycle electric motor is furnished mounted on an adjustable metal support.



No. 6655

Without beakers or burner but otherwise complete as illustrated, with motor **62.50**

Prices with Motors Direct Current and Alternating Current of Different Windings on Application.

6655A ——, without electric motor **42.50**

No. 6659

WATER MOTORS. See page 71.

6659 SPEED REDUCING GEAR, geared 48 to 1. Fast running or driving pulley has three grooves, 2, 3, and 4 inches diameter, for round belt; the slow running pulley has two grooves, 2 and 4 inches diameter, for round belt. This Speed Reducing Gear will be found well adapted to reduce the speed of motors in running various types of stirring apparatus **8.50**

No. 6660

No. 6661

Nos. 6662a-c

STOPCOCKS, BRASS. See **Knott's Gas Cocks,** page 6.

6660 **STOPCOCK, GLASS, FRESENIUS' FORM.** Bore one mm. . . . . Each **$1.50**

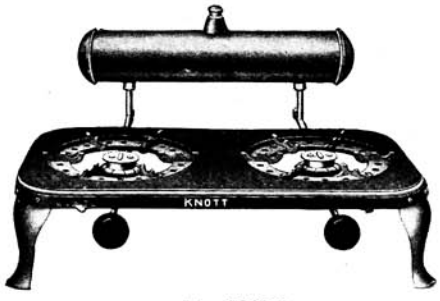
6661 **STOPCOCK, GLASS, two outlets,** 2 mm. bore, two oblique holes and two outlets on one side. **2.00**

6662 **STOPCOCKS, GLASS, GEISSLER'S.** Straight cocks carefully ground in by hand.

	a	b	c
Diameter of bore, mm.	1	2	3
Each.	**$1.25**	**1.30**	**1.53**

STORAGE BATTERY HYDROMETERS. See **Hydrometers.**

No. 6663B



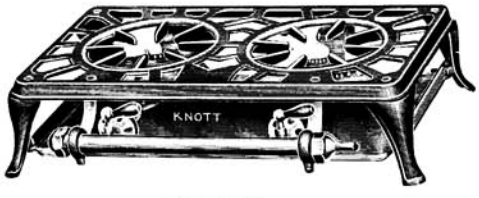
No. 6663C

6663A **STOVE, ALCOHOL,** for denatured alcohol. Diameter 6⅞ inches; height 6¾ inches. Will burn three hours without refilling. Wrought iron stand. **$4.25**

6663B **STOVE, ALCOHOL, Gravity Feed,** for denatured alcohol. Capacity 1¼ pints. Nickel-plated. . . . **7.75**

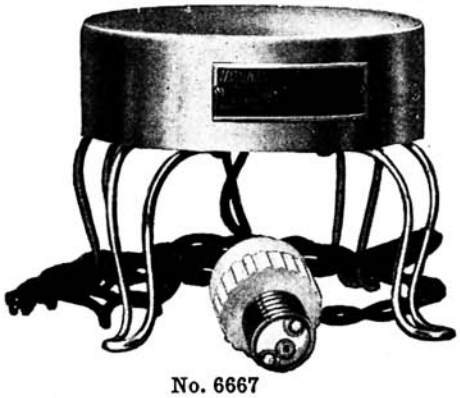
6663C ——, **Two-Burner.** Height of stove 5 inches; extreme height 11 inches; length 20 inches; width 10½ inches. **15.00**

No. 6664



No. 6665

6664 **STOVE, GAS,** top 12×12¾ inches, height 5 inches, finished in black, **drip pan, drawing out in front,** valves and supply pipes nickel plated and polished. **6.50**



No. 6667

6665 ——, **two burners,** top 22½×12 inches, height 5 inches **9.00**

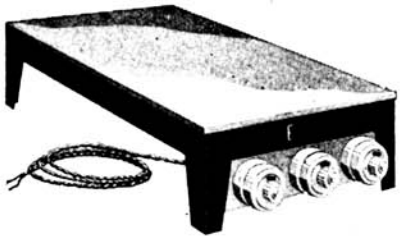
6667 **STOVE (HOT PLATE), ELECTRIC, ROUND.** Operates on 110 or 220 volt alternating current (60 cycles) or direct current. Life of heating element guaranteed for one year.

Diameter, 6 inches, pressed steel top, heavy bent wire legs, " blued " steel finish. Boils one liter of water from cold in 15 minutes. Maximum temperature 483° C. (900° F.). Current consumption 500 watts. With 6 feet twin conductor flexible cord and detachable connector plug (110 or 220 volts alternating current or direct current). **8.90**

6667A **EXTRA HEATING UNIT** for above. **4.45**

Note. When ordering **specify line voltage** and **whether alternating current or direct current.**

No. 6668



No. 6670

6668 **STOVE (HOT PLATE), ELECTRIC, SQUARE,** similar to above, but 12 inches square. Sheet steel top, cast iron legs, " blued " steel finish. Centrally heated by spiral resistance unit covering circular area 5¾ inches in diameter.

Maximum temperature at center, 260° C. (500° F.), temperature at edge 121° C. (250° F.) Current consumption 500 watts. With 6 feet flexible twin cord and detachable connector plug..... **$13.35**

6668A **EXTRA HEATING UNIT** for above..... **4.45**
Note. When ordering **specify line voltage and whether alternating current or direct current.**

STOVES (HOT PLATES), THREE HEAT ELECTRIC. Life of heating units guaranteed for one year. Sheet steel top and legs. " Blued steel " and black enamel finish.

Renewable resistance units composed of three parallel windings each connected by a snap switch on front of plate, heat distribution uniform. Low heat (246° C., 475° F.) obtained with one switch on; medium (316° C., 600° F.) with two switches on; high heat (399° C., 750° F.) with three switches on.

6669A **——, for 110 Volts Direct Current, size of plate 12×18 inches.** Current consumption—low, 600 watts; medium, 1200 watts; high, 1800 watts..... **63.85**

6669B **——, for 110 Volts, 60 Cycles**..... **63.85**

6669C **——, for 220 Volts Direct Current**..... **63.85**

6669D **——, for 220 Volts, 60 Cycles**..... **63.85**

6670A **——, for 110 Volts Direct Current, size of plate 18×24 inches.** Current consumption — low, 1200 watts; medium, 2400 watts; high, 3600 watts..... **97.25**

6670B **——, for 110 Volts, 60 Cycles**..... **97.25**

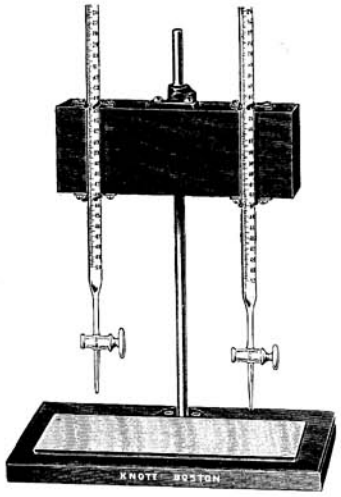
6670C **——, for 220 Volts Direct Current**..... **97.25**

6670D **——, for 220 Volts, 60 Cycles**..... **97.25**

6671 **EXTRA HEATING UNITS** for above.....Each **16.15**
Note. **Nos. 6669A-D** require one unit, but **Nos. 6670A-D** require two units.

No. 6675

6675 **SULPHUR APPARATUS, Meyer Bulb Tubes,** for determination of sulphur in iron by bromine method; 10 bulbs..... **2.50**



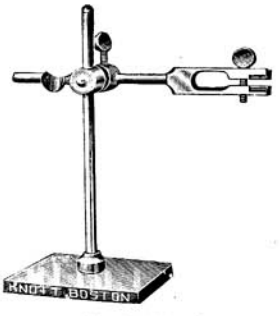
No. 6677

6677 **SUPPORT, BURETTE, Non-obstructed Reading.** Rectangular white vitrolite base, improved support clamp that holds burettes in true perpendicular lines and binds them firmly in place without danger of breakage. Note that readings are not obstructed by the clamp. Burette rests on board finished in white enamel to facilitate reading. Excellent for titrations **$9.75**

No. 6679

No. 6687

No. 6681



No. 6685

No. 6689

6679 **SUPPORT, FUNNEL,** as designed at Harvard College. A strip of hardwood with four beveled holes for 60° funnels. A V-Clamp attached to the index side of this strip permits attaching to the rods of supports **Nos. 6691** to **6693** **$0.60**

6681 **SUPPORT, FUNNEL, for 6 funnels.** H Metal Base, metal upright rod, wood funnel holder, with clamp **3.50**

6681A **WOOD FUNNEL HOLDER,** as used on above stand **2.00**

6685 **SUPPORT, GAY-LUSSAC'S IMPROVED,** of hardwood, cork-lined clamp with long ½-inch extension rod **2.50**

6687 **SUPPORT, SCHELLBACH'S UNIVERSAL,** of hardwood, cork-lined clamp with universal movement, height of clamp adjustable **2.75**

6689 **SUPPORT, PIPETTE, REVOLVING,** for 12 pipettes, of hardwood **4.75**

SUPPORTS

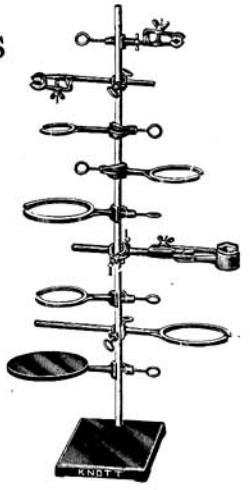
RING STANDS — RINGS — ATTACHMENTS

No. 6691

No. 6692

No. 6693

No. 6695b



No. 6701

RECTANGULAR BASES, bases japanned, rods coppered.

6691a	**Base and Rod only.** Small Base, 3¾×5¾ inches; rod, 18 inches	$0.45
6691b	**Base and Rod only.** Medium base, 4¾×7¾ inches; rod, 24 inches	.65
6691c	**Base and Rod only.** Large base, 5¼×8¾ inches; rod, 36 inches	1.00
6697a	**With Closed Rings No. 6463.** Small base, 3¾×5¾ inches; rod, 18 inches; rings, 2, 3 inches	.97
6697b	**With Closed Rings No. 6463.** Medium base, 4¾×7¾ inches; rod, 24 inches; rings, 2, 3, 4 inches	1.47
6697c	**With Closed Rings No. 6464.** Large base, 5¼×8¾ inches; rod, 36 inches; rings, 2, 3, 4, 5 inches	2.19
6694a	**With Open Side Filter Rings No. 6460.** Small base, 3¾×5¾ inches; rod, 18 inches; rings, 2, 3 inches	1.07
6694b	**With Open Side Filter Rings No. 6460.** Medium base, 4¾×7¾ inches; rod, 24 inches; rings, 2, 3, 4 inches	1.63
6694c	**With Open Side Filter Rings No. 6461.** Large base, 5¼×8¾ inches; rod, 36 inches; rings, 2, 3, 4, 5 inches.	2.43

TRIPOD BASES, bases japanned, rods coppered.

6692a	**Base and Rod only.** Small base, 3-inch leg; rod, 18 inches	.45
6692b	**Base and Rod only.** Medium base, 4-inch leg; rod, 24 inches	.65
6692c	**Base and Rod only.** Large base, 5½-inch leg; rod, 36 inches	1.10
6699a	**With Closed Rings No. 6463.** Small base, 3-inch leg; rod, 18 inches; rings, 2, 3 inches	.97
6699b	**With Closed Rings No. 6463.** Medium base, 4-inch leg; rod, 24 inches; rings, 2, 3, 4 inches	1.47
6699c	**With Closed Rings No. 6464.** Large base, 5½-inch leg; rod, 36 inches; rings, 2, 3, 4, 5 inches	2.29
6695a	**With Open Side Filter Rings No. 6460.** Small base, 3-inch leg; rod, 18 inches; rings, 2, 3 inches	1.07
6695b	**With Open Side Filter Rings No. 6460.** Medium base, 4-inch leg; rod, 24 inches; rings, 2, 3, 4 inches	1.63
6695c	**With Open Side Filter Rings No. 6461.** Large base, 5½-inch leg; rod, 36 inches; rings, 2, 3, 4, 5 inches	2.53

RINGS — ATTACHMENTS

6460 **RINGS FOR RING STANDS, Harcourt Open Side Filter Rings, Short Shank** for use on small and medium stands.

	a	b	c
Diameter, inches	2	3	4
Each	$0.30	.32	.36

6461 **——, same as above but with Long Shanks for use on large stands.**

	a	b	c	d
Diameter, inches	2	3	4	5
Each	$0.32	.34	.37	.40

6463 **——, Closed Short Shanks for use on small and medium stands.**

	a	b	c
Diameter, inches	2	3	4
Each	$0.25	.27	.30

6464 **——, same as above but with Long Shanks for use on large stands.**

	a	b	c	d
Diameter, inches	2	3	4	5
Each	$0.26	.28	.31	.34

6466 **EXTENSION RINGS, OPEN SIDE.** Require the use of Clamp Holder **No. 4017.**

	a	b	c
Diameter, inches	2	3	4
Each	$0.17	.20	.24

6468 **——, Closed for use with No. 4017 Clamp Holder.**

	a	b	c
Diameter, inches	2	3	4
Each	$0.14	.16	.20

6472 **RINGS, CONCENTRIC,** of cast iron, japanned, with **clamp** for use on ring or retort stands, to support funnels, flasks, etc.

	a	b
3 rings, largest ring, diameter, inches	6	
4 rings, largest ring, diameter, inches		8
Set	$0.90	1.20

6474 **RING PLATFORM,** cast iron, japanned, 5-inch diameter with clamp for use on ring stands. Can be used also as a hot plate. $0.75

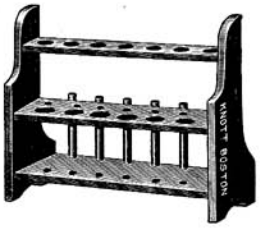
6693 **SUPPORT, "INSTITUTE" H-Base,** consists of a neatly japanned cast-iron base of distinctive shape with Bessemer rod. The curvature of the base legs is so patterned that the experimenter can place a jar or other apparatus within one inch of the support rod. The curvature is somewhat greater than that of a 4×5-inch battery jar. Any of the above rings or attachments may be used to advantage on this support. Base and rod only. 1.50

6701 **THE HARCOURT LECTURE TABLE RING STAND AND ATTACHMENTS.** Consists of extra large ring stand with 4 clamp holders, Universal Clamp **No. 4000,** Condenser Clamp **No. 4006,** Quick Acting Condenser Clamp **No. 4013** 3 Harcourt Open Side Rings, 2, 3 and 4-inch, **Nos. 6460a** to **6460c,** 2 Harcourt Open Side Extension Rings, 3 and 4-inch, **Nos. 6466b** and **6466c,** and Platform Support **No. 6474.** Complete outfit. 7.50

No. 6710

No. 6711

No. 6713



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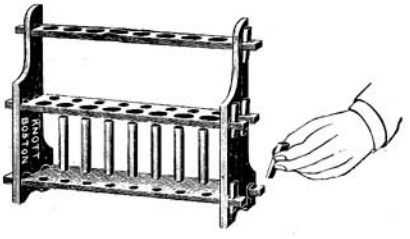

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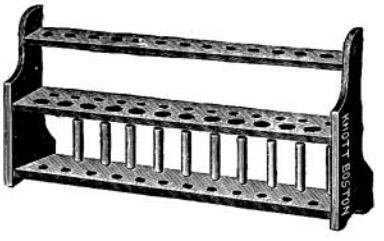

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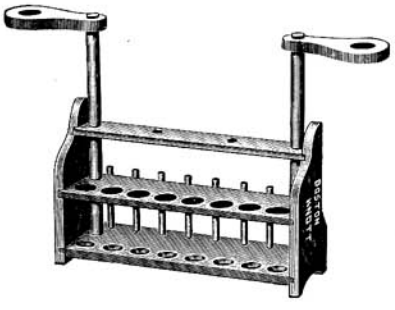
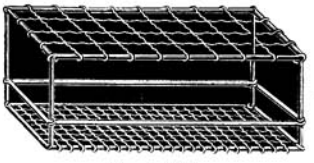


No. 6722



No. 6724

No. 6726

6710 **SUPPORT, TEST TUBE,** for 4 tubes, with 4 drying pins **$0.75**

6711 **——, for 6 tubes,** with 6 drying pins ..... **.90**

6713 **SUPPORT, TEST TUBE,** for 12 tubes, with 12 drying pins; 10 holes are 15/16 inch diameter, 2 holes 1⅛ inches diameter, with drain groove **1.10**

6715 **SUPPORT, TEST TUBE,** for 13 tubes, with drying pins ..... **.85**

6717 **——, for 25 tubes,** with drying pins **1.50**

6719 **SUPPORT, KNOCKED DOWN TEST TUBE.** This support occupies a very small compass when packed for shipment. It is very readily assembled, offering a substantial support. For sixteen tubes with drying pins **1.15**

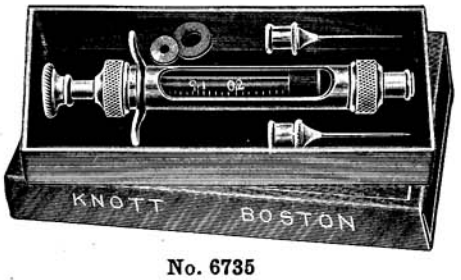
6720 **——, for 25 tubes,** with drying pins **1.80**

6722 **SUPPORT, TEST TUBE AND FUNNEL,** after Irish for 8 tubes; with drying pins; two adjustable funnel supports **2.25**

6724 **SUPPORT, TEST TUBE, WIRE,** galvanized iron wire rack for 36 test tubes ..... **.80**

6726 **SUPPORT, TEST TUBE,** for drying tubes, with 50 drying pins **3.00**

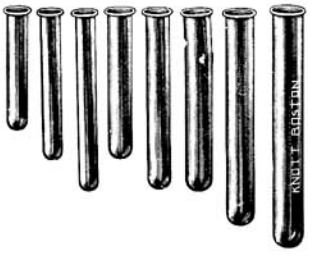
6727 **——, with 25 drying pins** **2.40**



No. 6735

6735 SYRINGE, HYPERDERMIC, 1 to 25 minims. The distinctive feature of this syringe is that the barrel is ground to fit the metal parts and the syringe may be disassembled for cleaning. With two steel needles in pasteboard box **$2.25**

No. 5642



Nos. 6795a-h

No. 6800

No. 6802

No. 6804

No. 6806

5795 TABLES, LOGARITHM, a heavy board card, 14½×9½ inches, with four place tables of logariths and antilogariths, with table of atomic weights, also Factors for Analysis. Computed by Dr. Hubert G. Shaw. This card is of convenient size for students' use in the laboratory. Used extensively and for years at the Massachusetts Institute of Technology ..... Each **$0.45**

5642 TEST GLASSES, on foot, clear colorless glass

	a	b
Capacity, ounces	2	4
Each	**$0.90**	**1.00**

6795 TEST TUBES, colorless glass tubes of special glass, resistant to changes in temperature.

	a	b	c	d	e	f	g	h
Length, inches	4	4	5	5	6	6	6	8
Diameter, inches	½	⅝	⅝	¾	⅝	¾	1	1
Per gross	**$2.20**	**2.40**	**2.85**	**3.00**	**3.25**	**3.80**	**4.75**	**6.50**

6796 ——, "PYREX" GLASS (see index, **"Pyrex" Glassware** for characteristics.)

	a	b	c	d
Length, mm	100	125	150	200
Diameter, mm	12	15	18	25
Per dozen	**$0.96**	**1.20**	**1.60**	**3.35**

6798 TEST TUBES, FUSED SILICA (see index, **"Fused Silica Ware,"** for characteristics). These test tubes are of great service in laboratory work, as they withstand high temperatures and can be cooled rapidly without breakage.

	a	b	c	d	e	f
Size, inches, inside	4×½	5×½	5×⅝	6×⅝	6×¾	7×⅞
Each	**$1.10**	**1.35**	**1.60**	**1.95**	**2.34**	**3.00**

6800 TEST TUBES, BOSTON BOARD OF HEALTH, without flange, heavy wall, 5 inches long×⅝-inch diameter ..... Per gross **4.75**

6802 TEST TUBES WITH SIDE NECKS.

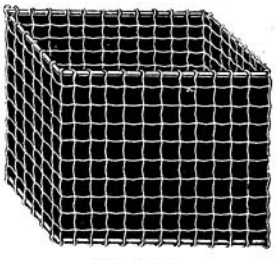
	a	b	c
Length, inches	6	8	9
Each	**$0.14**	**.18**	**.33**

6804 TEST TUBES ON FOOT, colorless glass tubes on pedestal bases.

	a	b	c	d
Height, inches	4	5	6	8
Diameter, inches	½	⅝	¾	1
Each	**$0.15**	**.17**	**.20**	**.35**

6806 TEST TUBES, GRADUATED.

	a	b	c
Capacity, cc	10	20	30
Graduated to cc	1/10	1/10	1/5
Each	**$0.45**	**.55**	**.65**



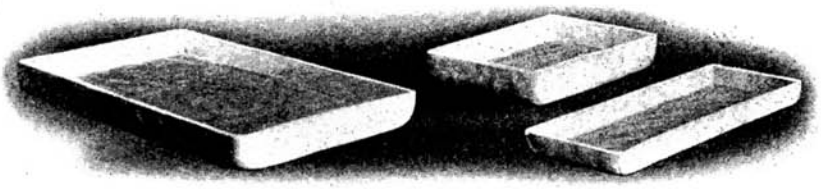
No. 6815

6815 TEST TUBE BASKETS for sterilizing in bacteriological work ..... Each **$0.80**

3810 TEST TUBE BRUSH, bristle end, wire handle. (For illustration see page 212.) ..... **.10**

3811 TEST TUBE BRUSH, sponge end, wire handle. (For illustration see page 212) ..... **.12**

4040 TEST TUBE CLAMP, spring wire. (For illustration see page 223) ..... **.10**



No. 6834

THERMOMETERS, all kinds. See pages 102 and 103.

THERMO-REGULATORS. See **Gas Regulators,** page 253.

6955 THISTLE TUBES.

	a	b	c
Length, inches	10	12	15
Each	**$0.12**	**.15**	**.16**

5075 TONGS, CRUCIBLE, steel, double bend, 9-inch **$0.25**

5076 ——, nickel-plated . . . . . **.40**

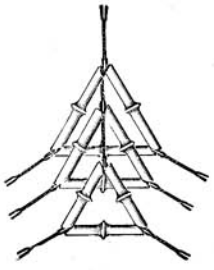
6828 TOWELS, LABORATORY, non-linting, perfectly absorbent, superior quality, 18×36 inches . . . . . Each **.30**
On lots of 100 or more special quantity prices, depending upon market. Per dozen **3.00**

6830 TRAYS, GLASS (Photo Trays), crystal glass.

	a	b	c
Size, inches	4×6	5×8	8×10
Each	**$0.35**	**.50**	**1.00**

6834 TRAYS, FUSED SILICA, rectangular. (See index, **"Fused Silica Ware,"** for characteristics.)

	b	e	f	g	h
Length, outside, inches	9¼	14	15¾	16¾	16¾
Width, outside, inches	2⅝	4⅝	9½	11¼	13⅜
Depth, outside, inches	1	1	1½	1½	1¾
Each	**$3.35**	**5.18**	**6.28**	**8.50**	**10.38**

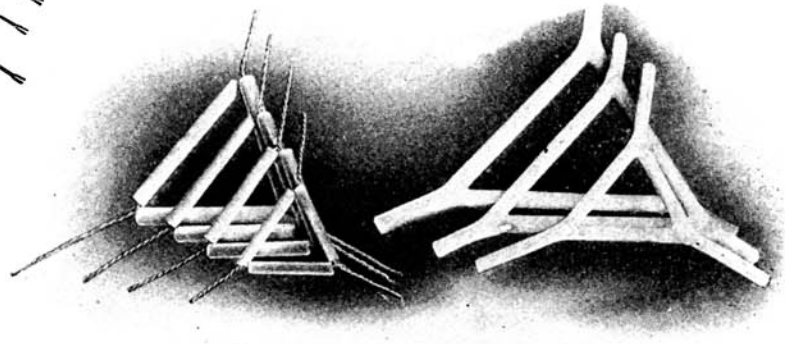


No. 6840a–c

6840 TRIANGLES, "PIPE STEM," iron wire, covered with porcelain raised centers.

	a Small	b Medium	c Large
Length of side, inside, inches	2¾	3	3¼
Each	**$0.17**	**.19**	**.22**

TRIANGLES, PLATINUM. See **Platinum Ware.**



No. 6842 No. 6843

6842 TRIANGLES, FUSED SILICA (Silica Tubes on Iron Wire). (See index, **"Fused Silica Ware,"** for characteristics.) Will outwear innumerable pipe-stem triangles.

	a	b	c	d	e	f	g	h	i	j	k
Length, inches	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
Each	**$0.28**	**.28**	**.28**	**.37**	**.37**	**.46**	**.46**	**.55**	**.55**	**.65**	**.65**

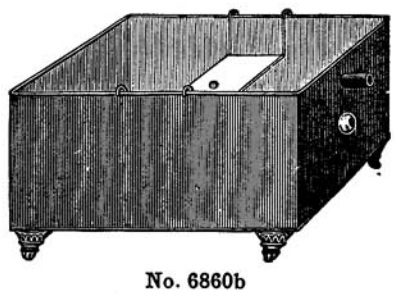
6843 TRIANGLES, FUSED SILICA (All Silica Tubes). (See index, **"Fused Silica Ware,"** for characteristics.)

	a	b	c	d	e	f	g	h	i	j	k
Length, inches	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
Each	**$1.65**	**1.65**	**1.65**	**1.93**	**1.93**	**2.25**	**2.25**	**2.25**	**2.50**	**2.50**	**2.78**

No. 6850

No. 6852

No. 6855



No. 6860b

6850 TRIPOD, japanned iron, 8 inches high. Inside diameter of ring 3½ inches, with three legs..... **$0.45**

6852 TRIPODS, japanned iron, 8 inches high.

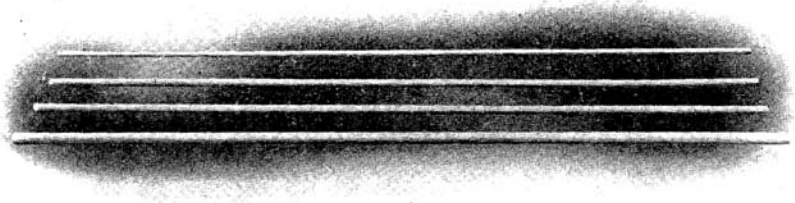
	a	b	c	d	e
Inside diameter, inches	3	4½	6	8	10
Outside diameter, inches	5	6	8	10	12
Each.....	**$0.45**	**.60**	**.85**	**1.10**	**1.60**

6855 TRIPODS, CONCENTRIC RINGS, japanned iron, 8 inches high. Diameters given are outside measurements of largest ring.

	a	b	c	d	e
No. of Rings.....	2	3	4	5	6
Diameter, inches.....	5	6	8	10	12
Set.....	**$0.70**	**.95**	**1.30**	**1.65**	**2.35**

6860 TROUGHS, PNEUMATIC, heavy gauge metal, each size with sliding shelf and overflow tube.

	a	b	c
Length, inches.....	9	12	14⅜
Width, inches.....	6¼	9	8½
Depth, inches.....	3⅝	5	5
Each.....	**$1.65**	**2.00**	**3.00**



6868 TUBING, FUSED SILICA COMBUSTION. (See index, **"Fused Silica Ware,"** for characteristics.) Fused Silica Combustion Tubes are largely employed in electric resistance furnaces for the determination of carbon, oxygen, and sulphur in iron, steel and other non-volatile metals; for the determination of sulphur in pyrites cinder, and for the determination of carbon, hydrogen, halogens and sulphur in organic compounds.

The superior heat and chemical resisting properties of Fused Silica have led to the general adoption of tubes of this material to replace glass, porcelain and platinum in combustion work.

Numbers a-f have a **satin surface,** numbers h-n have an **unglazed** surface.

	a	b	c	d	e	f	
Bore, inch.....	1/32–1/16	1/8	3/16	1/4	5/16	3/8	
Thickness of wall, mm.....	.5–1	.75–1	1–1.5	1–2	1–2	1–2	
Price per foot.....	**$0.38**	**.62**	**.98**	**1.36**	**1.60**	**1.86**	
Extra price per tube for closed end..	**$0.17**	**.22**	**.28**	**.35**	**.35**	**.40**	
	h	**i**	**j**	**k**	**l**	**m**	**n**
Bore, inch.....	½	9/16	5/8	11/16	¾	⅞	1
Thickness of wall, mm.....	1–2	1–2.5	1–2.5	1–2.5	1–3	1–3	1–3
Price per foot.....	**$2.25**	**2.33**	**2.44**	**2.78**	**3.20**	**3.38**	**3.72**
Extra price per tube for closed end..	**$0.45**	**.50**	**.60**	**.72**	**.83**	**.94**	**1.00**

6875 TUBES, ARSENIC, hard glass.

a	b	c	d
$0.10	**.10**	**.10**	**.10**

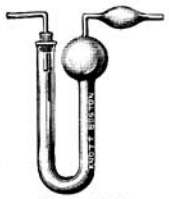
Set of four (see illustration, page 197)..... **$0.35**

No. 6920

No. 6880

No. 6882

No. 6884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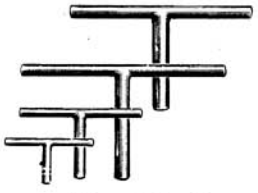
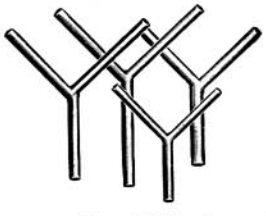
No. 6887 No. 6888

No. 6900


Nos. 6906a-d

No. 6902

No. 6904


Nos. 6908a-d

No. 6909a-c

No. 31–145A

No. 6911

6880 TUBES, CALCIUM CHLORIDE, U-shape, Plain.

	a	b	c	d
Size, inches	3×¾	4×¾	5×¾	6×¾
Each	$0.20	.22	.25	.30

6882 TUBE, CALCIUM CHLORIDE, 6 inches long, designed to lie **flat** on the table. A most convenient and useful type. **$0.65**

6884 TUBES, CALCIUM CHLORIDE, U-SHAPE, with **side tubes.**

	a	b	c
Size, inches	4×¾	6×¾	8×¾
Each	$0.30	.45	.75

6887 TUBES, CALCIUM CHLORIDE, straight with one bulb.

	a	b	c
Size, inches	4×¾	6×¾	8×¾
Each	$0.15	.18	.24

6888 TUBES, CALCIUM CHLORIDE, straight with two bulbs.

	a	b	c
	Small	Medium	Large
Size, inches	4×¾	6×¾	8×¾
Each	$0.17	.20	.26

6890 TUBES, CALCIUM CHLORIDE, Marchand's.

	a	b
Size, inches	4×¾	6×¾
Each	$0.45	.75

6895 TUBE, CHLORINE (see Newell's "Descriptive Chemistry," Exp. 23) **1.00**

6900 TUBE, CONNECTING, BRASS, for reducing from $\frac{7}{16}$ to $\frac{9}{32}$ inch . . . . . **.25**

6902 TUBES, CONNECTING, BRASS, T Shape

	a	b	c
Diameter, inch	5/16	3/8	½
Each	$0.60	.65	.75

6904 TUBES, CONNECTING, BRASS, Y Shape

	a	b	c
Diameter, inch	5/16	3/8	½
Each	$0.60	.65	.75

6906 TUBES, CONNECTING, GLASS, T Shape.

	a	b	c	d
Diameter, inch	¼	5/16	3/8	½
Each	$0.16	.18	.30	.40

6908 TUBES, CONNECTING, GLASS, Y Shape.

	a	b	c	d
Diameter, inch	¼	5/16	3/8	½
Each	$0.16	.18	.30	.40

6909 TUBES, CONNECTING, GLASS, ∨ Shape.

	a	b	c
Diameter, inch	¼	5/16	3/8
Each	$0.18	.22	.25

31–145A TUBE, CONNECTING, LEAD, Y Shape, ¼ inch . . . . . **.50**

6911 TUBE, CONNECTING, WHITE METAL, Y Shape, for ⅜-inch rubber tubing . . . . . **.30**

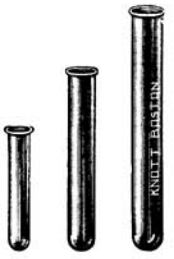
6920 TUBES, CULTURE, of medium heavy glass, round bottom, no lip.

	a	b	c
Size, inches	4×½	5×⅝	6×¾
Per dozen	$0.40	.48	.54

TUBES, DISTILLING. See **Distilling Tubes.**

No. 6923

No. 6925



Nos. 6938a-c

No. 6950

No. 6952

No. 6955

No. 6960

No. 5620b

6923 TUBE, FERMENTATION, with graduated test tube. (Dr. Einhorn's Saccharometer.)
With directions **$1.10**

6925 TUBES, FERMENTATION, ungraduated, on foot.

	a	b
Length, inches	5¾	6¾
Diameter, inch	½	⅝
Each	**$0.35**	**.45**

6930 TUBES, FILTER (CARBON FILTERS). Stems ground to a point.

	a	b	c
Diameter of top, mm.	25	32	35
Each	**$0.35**	**.45**	**.55**

5620 TUBES, GAS, for collecting gases over mercury.

	a	b
Capacity, cc	50	100
Subdivided, cc	1/5	½
Each	**$1.25**	**2.00**

6796 TUBES, IGNITION, "PYREX" GLASS (see index, **"Pyrex" Glassware,** for characteristics).

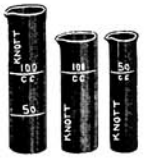
	a	b	c	d
Length, mm	100	125	150	200
Diameter, mm	12	15	18	25
Per Dozen	**$0.96**	**1.20**	**1.60**	**3.35**

6938 TUBES, IGNITION, of superior quality hard, heavy glass, best for generating oxygen.

	a	b	c
Length, inches	4	6	8
Diameter, inch	½	⅝	1
Each	**$0.13**	**.17**	**.40**

6945 TUBES, NESSLER'S, for ammonia tests in water analyses; of colorless glass.

	a	b	c
Graduated, cc	50	100	50 & 100
Each	**$0.75**	**.90**	**1.10**



No. 6945

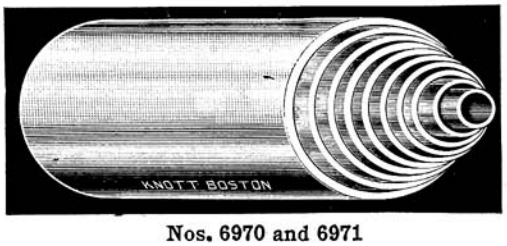
6950 TUBE, SAFETY, thistle top, one bulb in bend, length 12 inches **$0.35**
6952 TUBE, SAFETY, thistle top, bend in stem. Length 12 inches ..... **.30**
TUBES, SPECIMEN. See **Vials.**

6955 TUBES, THISTLE.

	a	b	c
Length, inches	10	12	15
Each	**$0.12**	**.15**	**.16**

6960 TUBE, VINEGAR, Massachusetts Board of Health, for determining the percentage of alcohol ..... **.45**

Outside Diameter mm.	Approximate Feet per lb.
4	78
5	60
5½	55
6	48
6½	45
7	41
8	35
9	31
10	28



Nos. 6970 and 6971

Outside Diameter mm.	Approximate Feet per lb.
12	23
15	14
18	11
20	10
22	9
25	8
30	—
35	—
40	—

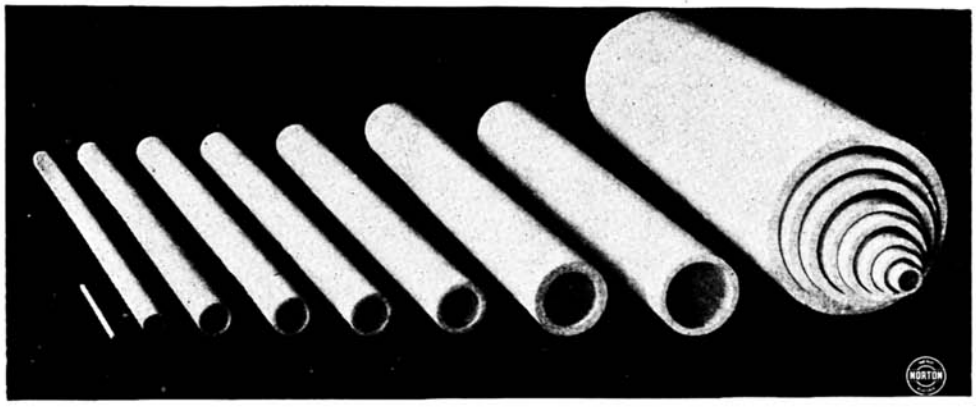
6970 TUBING, GLASS, best quality, free from lead, especially adapted for glass blowing and bending, usual wall for chemical laboratory purposes. The following sizes are carried in stock — 4, 5, 5½, 6, 6½, 7, 8, 9, 10, 12, 15 and 18 mm. outside diameters ..... Per lb. **$0.60**

6971 ——, same as above in quality, but larger in diameter. The following sizes are carried in stock—20, 22, 25, 30, 35 and 40 mm. outside diameters ..... Per lb. **.75**

Note. **In ordering Glass Tubing, always specify the diameter desired.**

6973 TUBING, GLASS CAPILLARY, outside diameter 6-7 mm., bore ½, 1 and 1½ mm. (In ordering specify bore desired) ..... Per lb. **1.15**

6975 TUBING, GLASS BAROMETER, outside diameter 8-9 mm., bore 3 mm. ..... Per lb. **.90**



Nos. 6977 to 6979

6977 TUBING, ALUNDUM (see index, "**Alundum Ware,**" for characteristics). Length 12 inches.

	a	b	c	d
Bore, inch	½	⅝	¾	1
Wall, inch	⅛	⅛	⅛	⅛
Each	**$2.25**	**2.25**	**2.25**	**2.25**

6978 ——, length 18 inches.

	a	b	c	d
Bore, inch	½	⅝	¾	1
Wall, inch	⅛	⅛	⅛	⅛
Each	**$3.35**	**3.35**	**3.35**	**3.35**

6979 ——, length 24 inches

	a	b	c	d
Bore, inch	½	⅝	¾	1
Wall, inch	⅛	⅛	⅛	⅛
Each	**$4.45**	**4.45**	**4.45**	**4.45**

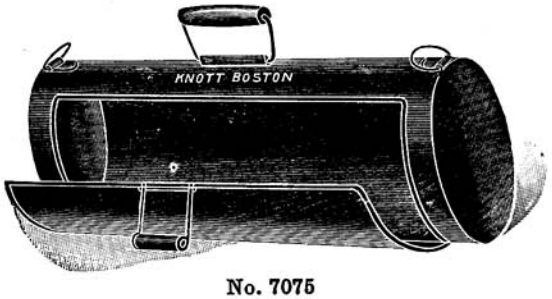
Note. Alundum Tubes up to 10-inch bore by ½-inch wall can be obtained. Prices on application. A charge of 10 per cent additional to above prices will be made for closing one end of the tube.

6982 TUBING, GLASS COMBUSTION, of hard glass, melting point 800° C. Outside diameter 8, 10, 13, 19, and 25 mm. (In ordering specify sizes desired) . . . . . Per lb. **$1.30**

6986 TUBING, PORCELAIN COMBUSTION. Glazed outside. Will stand a temperature of 1800 degrees Fahrenheit and is practically gas tight. In lengths of one meter.

	a	b	c	d	e	f
Inside diameter, mm.	6	10	15	20	25	28
Outside diameter, mm.	10	14	20	28	30	38
Per length, one meter	**$7.46**	**7.46**	**9.33**	**11.19**	**12.14**	**14.93**

6990 TUMERIC PAPER . . . . . Per sheet **$0.10** Per book **.10** Per quire **.75**



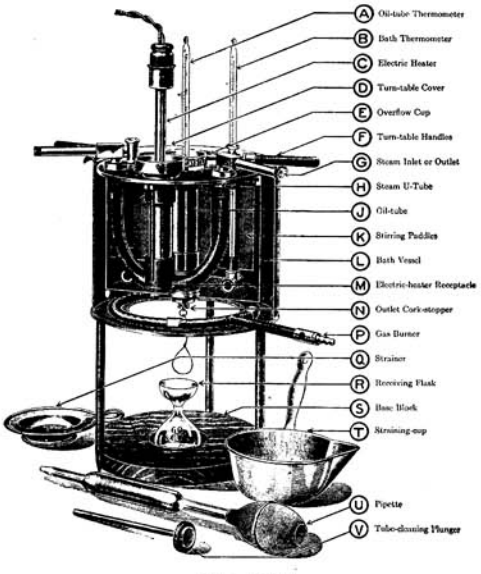
No. 7075

Nos. 7080a-f

7075 VASCULUM OR COLLECTING CASE, of metal, with shoulder straps. Size 18×6½×4½ inches. . **$4.50**

7080 VIALS, Shell Vials, round, straight wall, for use with corks.

	a	b	c	d	e	f
Capacity, drams	1	2	3	4	6	8
Height, mm	45	55	60	65	70	75
Diameter, mm	15	17	19	21	23	25
Per dozen	**$0.14**	**.17**	**.23**	**.32**	**.42**	**.52**



No. 7087

No. 7085

Nos. 7095a-i

No. 7100

7085 **VISCOSIMETER, SCOTT'S,** for determining the viscosity of oils, etc. A reliable instrument comparing very favorably with those of much higher price..... **$22.50**

7087 **VISCOSIMETER, SAYBOLT'S UNIVERSAL STANDARD,** adapted for steam, gas, or electric heating, for testing cylinder, valve and similar oils with bath at 212° F. and oil at 210° F.; for testing reduced black oils with bath about and oil at 130° F.; for testing neutral, spindle, paraffine, red, and other distilled oils with bath about and oil at 100° F., or at any temperature up to 212° F. Equipped with an electric heating device, a U-tube, steam heater, and a gas burner, in addition to a turn-table stirring arrangement which permits any one to work easily and accurately up to the temperature of boiling water. The bath liquid prescribed is a paraffine, pale engine oil, of about 350° to 400° flash, to be used for viscosity tests at all temperatures. The substitution of oil for water avoids the common difficulty arising from the mixture of water with the oil under test. Complete as illustrated including six thermometers and a stop watch..... **111.25**

7087A **——, without stop watch** **100.00**

7087B **THERMOMETER,** solid glass, etched scale, 70° to 110° F. as used in Saybold Viscosimeter..... **4.00**

7037C **——, 100° to 140° F.**..... **4.00**

7087D **——, 180° to 220° F.**..... **4.00**

5434 **RECEIVING GLASS,** 60 cc., as used in Saybold Viscosimeter..... **1.40**

7090a **VISE, LABORATORY,** ¾×1 inch, length of jaw, 1½ inches, opens 2 inches..... **1.25**

7090b **——, 1×1¼ inches,** length of jaw 2 inches, opens 2½ inches..... **2.75**

VOLUMETRIC FLASKS. See **Flasks, Volumetric.**

WASHING BOTTLES. See **Bottles.**

7095 **WATCH GLASSES, thin and well annealed.**

	a	b	c	d	e	f	g	h	i
Diameter, inches.....	1	1½	2	2½	3	3½	4	5	6
Per dozen.....	**$0.70**	**.75**	**.90**	**1.05**	**1.20**	**1.35**	**1.65**	**1.90**	**2.50**

7097a **WATCH GLASSES, COUNTERPOISED, in pairs,** accurately adjusted for analytical balances, diameter 2½ inches.....Per pair **1.50**

7097b **——,** diameter 3 inches.....Per pair **1.50**

7100 **WATCH GLASSES, SYRACUSE,** outside diameter 70 mm., inside diameter 53 mm.....Per dozen **.90**

7110 **WATCH SPRINGS**.....Per dozen **.30**

82-30 **WAX, SEALING,** in sticks.....Per lb. **1.20**

7120 **WAX TAPERS**.....Per box **.15**

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Detailed Circular Sent Upon Request

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2. **Berthollet** (French Chemist)
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6. **Bunsen** (German Chemist)
7. **Cannizzaro** (Italian Chemist)
8. **Cavendish** (English Chemist)
9. **Mme. Curie** (French Chemist)
10. **Dalton — Middle Life** (English Chemist)
11. **Dalton — Old Age**
12. **Dalton's Apparatus I**
13. **Dalton's Apparatus II**
14. **Dalton's Apparatus III**
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16. **Davy — Later Life**
17. **Davy's Statue at Penzance**
18. **Davy's Apparatus**
19. **Dewar** (English Chemist)
20. **Dumas** (French Chemist)
21. **Faraday — Early Life** (English Chemist)
22. **Faraday — Old Age**
23. **Faraday's Apparatus I**
24. **Faraday's Apparatus II**
25. **Fourcroy** (French Chemist)
26. **Gay-Lussac** (French Chemist)
27. **Graham** (British Chemist
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29. **Hales** (English Chemist)
30. **Lavoisier** (French Chemist)
31. **Lavoisier's Monument**
32. **Liebig** (German Chemist)
33. **Mendelejeff** (Russian Chemist)
34. **Moissan** (French Chemist
35. **Ostwald** (German Chemist)
36. **Paracelsus** (Swiss Alchemist)
37. **Pasteur** (French Chemist)
38. **Priestley** (English Chemist)
39. **Priestley's Statue at Birmingham**
40. **Priestley's Apparatus**
41. **Proust** (French Chemist)
42. **Ramsey** (English Chemist)
43. **Scheele** (Swedish Chemist)
44. **Stahl** (German Chemist)
45. **Stas** (Belgian Chemist)
46. **Van Helmont** (Dutch Chemist)
47. **Van't Hoff** (Dutch Chemist)
48. **Vauquelin** (French Chemist)
49. **Von Humboldt** (German Scientist)
50. **Wohler** (German Chemist)

SERIES "B." HISTORICAL CHEMISTRY

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58. **Aristotle's Four Elements**
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62. **Bacon, Roger** (English Philosopher)
63. **Boerhaave** (Dutch Chemist)
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85. **Mayow** (English Chemist)
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87. **Meyer, Victor** (German Chemist)
88. **Meyer's Apparatus**
89. **Moissan's Fluorine Apparatus**
90. **Newton** (English Philosopher)
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93. **Raymond Lulli** (Spanish Alchemist)
94. **Remsen** (American Chemist)
95. **Richards** (American Chemist)
96. **Rumford** (American Philosopher)
97. **Rutherford, Daniel** (Scotch Botanist)
98. **Rutherford, Ernest** (English Physicist)
99. **Thenard** (French Chemist)
100. **Thomas Aquinas** (Italian Philosopher)
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102. **Volta** (Italian Physicist)
103. **Watt** (British Physicist)
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7–100C Henry
7–100D Tyndall
7–100E Helmholtz
7–100F Kelvin
7–100G Rowland
7–100H Galileo
7–100I Boyle

Chemists

7–125A Priestley
7–100B Faraday
7–125B Lavoisier
7–125C Dalton
7–125D Davy
7–125E Bunsen
7–125F Ostwald
7–125G Liebig
7–125H Wöhler
7–125I Moissan
7–125J Remsen
7–125K Pasteur
7–125L Mendelejeff
7–100I Boyle

Biologists

7–125K Pasteur
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Price, Single picture **$1.25**
Selection of any 6 ..... **6.75**
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CHEMICALS—REAGENTS

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Acacia (Gum Arabic)	$0.20	$0.35	$0.65	$1.25	.....
Acetamide, crystallized	.85	....	....	....	.....
Acetone, C. P.	....	....	....	1.25	.....
Acid, Acetic, commercial, about 30%	....	....	....	.45	5 lb. $1.25
" **Acetic,** glacial	....	....	....	.50	.....
" **Acetic,** C. P., analyzed 99.5%	....	....	....	1.00	5 lb. 3.50
" **Arsenious** (Arsenic Trioxide) powdered technical	.20	.35	.50	.85	.....
" **Boric,** commercial	.12	.20	.30	.50	.....
" **Boric,** crystallized, C. P.	.20	.35	.60	1.00	5 lb. 4.25
" **Carbolic,** crystallized, pure	.20	.30	.45	.75	.....
" **Chloroplatinic** (Platinum Chloride) Solution 5%	5.00	....	....	....	.....
" **Chromic** (Chromium Trioxide) technical	.30	.60	1.00	1.80	.....
" **Chromic ,** C. P.	....	....	....	....	5 lb. 14.00
" **Citric,** crystallized, U. S. P.	.20	.35	.65	1.25	.....
" **Citric,** crystallized, C. P.	.35	.75	1.25	2.25	5 lb. 9.00
" **Fluosilicic** (Acid Hydrofluosilicic)	.35	.70	1.10	2.00	.....
" **Formic,** technical	.25	.55	....	....	.....
" **Hydrochloric,** commercial	....	....	....	.50	6 lb. 1.25
" **Hydrochloric,** C. P., analyzed (Baker)	....	....	....	.70	6 lb. 1.95
" **Hydrofluoric** (Hydrogen Fluoride) 48% commercial	.50	.75	....	....	.....
" **Hydrofluosilicic,** technical	.35	.70	1.10	2.00	.....
" **Molybdic,** pure	.60	1.25	2.00	3.50	.....
" **Molybdic,** C. P. 85%	....	....	....	4.00	.....
" **Muriatic** (Acid Hydrochloric)	....	....	....	.50	6 lb. 1.25
" **Nitric,** commercial	....	....	....	.55	7 lb. 1.90
" **Nitric,** C. P. analyzed (Baker)	....	....	....	.80	7 lb. 2.95
" **Oxalic,** crystallized, technical	.15	.25	.45	.75	.....
" **Oxalic,** crystallized, C. P.	.25	.50	.80	1.40	5 lb. 5.75
" **Perchloric,** C. P. 20%	....	....	2.00	....	.....
" **Phosphoric,** ortho, 85% syrupy, U. S. P.	.25	.50	.70	1.10	.....
" **Phosphoric,** ortho, 85% C. P.	....	....	....	1.35	5 lb. 5.00
" **Pyrogallic,** pure, crystallized	.40	1.00	....	....	.....
" **Salicylic,** U. S. P.	.15	.35	....	....	.....
" **Stearic,** commercial	.15	.30	....	....	.....
" **Sulfuric,** commercial (Oil of Vitriol)	....	....	....	.45	9 lb. 1.50
" **Sulfuric,** C. P. analyzed (Baker)	....	....	....	.60	9 lb. 2.45
" **Sulfuric,** C. P. arsenic free	....	....	....	.85	.....
" **Tannic** (Tannin) pure	.30	.75	1.25	2.25	.....
" **Tannic,** C. P.	.40	1.25	....	....	.....
" **Tartaric,** crystallized, pure	.20	.35	.65	1.25	.....
" **Tartaric,** crystallized, C. P.	....	....	....	2.00	5 lb. 8.25
Agar Agar (Chinese Isinglass)	.25	.75	1.50	3.00	.....
Albumen (from blood)	.35	.75	1.25	2.50	.....
Alcohol, denatured	....	....	....	....	Pt. .50 Qt. .75 Gal. 1.75
" **Methyl,** absolute	....	....	....	....	Gal. 1.25
Alizarine, paste, 20%	.60	1.25	....	....	.....
Alum, Ammonia (Aluminum Ammonium Sulfate)	.12	.20	.30	.45	.....
" **Chrome** (Chromium Potassium Sulfate)	.15	.25	.40	.75	.....
" **Ferric** (Iron (ic) Ammonium Sulfate)	.20	.30	.40	.65	.....
" **Potassium** (Aluminum Potassium Sulfate)	.10	.15	.22	.35	.....
Aluminum, Metal, lumps	....	....	.40	.75	.....
" **Metal,** leaf	....	....	....	....	Roll .60

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Aluminum Metal, sheet	$0.15	$0.50	$0.90	$1.75	
" **Metal,** shot	....	....	.50	.95	
" **Acetate,** basic powder	.25	.65	....	....	
" **Ammonium Sulfate,** crystallized	.12	.20	.30	.45	
" **Ammonium Sulfate,** crystallized, C. P.	....	....	....	....	5 lb. $3.25
" **Chloride,** crystallized, pure	.25	.50	.85	1.60	
" **Chloride,** crystallized, C. P.	.30	.60	1.00	2.00	
" **Hydroxide,** native (Bauxite)	....	....	....	.35	
" **Nitrate,** crystallized, C. P.	....	....	....	1.40	
" **Oxide** (ignited), C. P.	....	....	....	2.00	
" **Potassium Sulfate** (Potassic Alum)	.10	.15	.22	.35	
" **Potassium Sulfate,** crystallized, C. P.	....	....	....	.95	5 lb. 3.75
" **Sodium Sulfate,** crystallized, C. P.	....	....	....	1.25	
" **Sulfate,** technical, crystallized	.15	.20	.25	.40	
" **Sulfate,** crystallized, C. P.	....	....	.75	1.25	
Alundum, powdered, 60 mesh	....	....	.75	....	
Amalgam, Sodium	.60	1.50	2.75	5.00	
Amidobenzene (Aniline)	.20	.45	.65	....	
Ammonium Acetate, crystallized. C. P.	....	....	....	1.35	5 lb. 5.25
" **Bicarbonate,** C. P.	....	....	....	.90	5 lb. 4.00
" **Bi- or Dichromate,** pure	.22	.45	.70	1.25	
" **Bi- or Dichromate,** C. P.	....	....	....	2.50	5 lb. 11.00
" **Bisulfite,** concentrated, solution, C. P.	....	....	....	1.50	
" **Carbonate**	.15	.30	.40	.65	
" **Carbonate,** C. P.	.20	.35	.60	1.00	
" **Carbonate,** C. P. cubes	....	....	....	....	5 lb. 4.50
" **Chloride** (Sal Ammoniac), gran	....	.12	.20	.35	5 lb. 1.60
" **Chloride,** C. P.	.20	.35	.55	.95	5 lb. 3.50
" **Hydrate** or **Hydroxide**	....	....	....	.50	4 lb. 1.25
" **Hydrate** or **Hydroxide,** C. P.	....	....	....	.75	4 lb. 1.90
" **Hydrosulfide**	....	.45	.65	1.00	
" **Hydrosulfide,** C. P. (light)	....	....	....	1.10	5 lb. 3.75
" **Molybdate,** crystallized, pure	.40	1.50	....	....	
" **Molybdate,** crystallized, C. P.	.50	1.55	....	4.75	
" **Nitrate**	.20	.30	.45	.80	
" **Nitrate,** C. P.	.25	.45	.70	1.25	5 lb. 5.00
" **Oxalate,** pure	.20	.45	.80	1.50	
" **Oxalate,** C. P.	.25	.65	1.00	1.85	5 lb. 8.00
" **Persulfate,** C. P.	....	....	....	1.75	
" **Phosphate,** secondary, C. P. (Dibasic)	....	....	....	1.90	5 lb. 8.50
" **Sulfate,** pure	.15	.20	.30	.45	
" **Sulfate,** C. P.	.20	.40	.55	.85	
" **Sulfide** (Hydro)	....	.45	.65	1.00	
" **Sulfide** (Hydro) C. P. (Light)	....	....	....	1.10	5 lb. 3.75
" **Sulfocyanate** (Ammonium Thiocyanate)	.45	....	....	....	
" **Tartrate,** C. P.	....	....	....	2.25	
" **Thiocyanate** (Ammonium Sulfocyanate)	.45	....	....	....	
Amyl Acetate	....	....	....	....	5 lb. 7.50
Aniline (Amidobenzene) pure	.20	.45	.65	....	
" C. P. (Oil)	....	....	1.00	....	
Antimony Metal	.15	.20	.30	.50	
" (ous) **Chloride, Tri,** C. P.	....	....	....	2.00	
" (ous) **Chloride, Tri,** crystallized	.30	.60	1.00	1.75	
" (ous) **Oxide, Tri,** C. P.	....	....	....	1.25	
" (ic) **Oxide, Penta,** C. P.	....	....	....	2.35	
" **Potassium Tartrate,** C. P.	....	....	....	2.00	
" **Potassium Tartrate** (Tartar Emetic)	.20	.35	.60	1.15	
" **Sulfate,** C. P.	....	....	....	1.95	
" (ous) **Sulfide, Tri- Black**	.15	.20	.30	.50	

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Arsenic Metal	$0.25	$0.40	$0.75	$1.25	.....
" (ous) **Oxide, Tri** (Acid Arsenious)	.20	.35	.50	.85	.....
Asbestos, shredded	.50	1.50	3.00	5.50	.....
" platinized, 5%	9.00	....	....	....	¼ oz. $3.00
Ascarite	....	....	....	7.50	.....
B					
Baking Powder, Cleveland	....	....	....	....	Can .35
" **Powder,** Royal	....	....	....	....	Can .35
" **Soda** (Sodium Bicarbonate)	....	.15	.18	.25	.....
Barium Acetate, C. P.	....	....	1.00	....	.....
" **Carbonate,** precipitated, pure	.15	.25	.45	.85	.....
" **Carbonate,** C. P.	.25	.45	.75	1.30	.....
" **Chloride,** crystallized	.15	.20	.30	.50	5 lb. 2.25
" **Chloride,** crystallized, C. P.	.20	.35	.50	.80	5 lb. 3.50
" **Chromate,** C. P.	....	....	....	3.00	.....
" **Di- or Peroxide,** C. P.	....	....	....	1.25	5 lb. 5.50
" **Di- or Peroxide**	.20	.35	.60	.95	.....
" **Hydroxide,** C. P.	....	....	....	1.70	5 lb. 7.25
" **Hydroxide, Dry,** Powdered (Barium Oxide, Powdered (hydrated))	.15	.25	.40	.65	.....
" **Nitrate**	.12	.20	.30	.50	5 lb. 2.25
" **Nitrate,** crystallized, C. P.	.20	.40	.60	1.00	5 lb. 4.00
" **Oxalate,** C. P.	.35	....	....	....	.....
" **Oxide,** powdered (hydrated), (Barium Hydroxide, dry, powdered)	.15	.25	.40	.65	.....
" **Phosphate,** C. P.	....	....	....	3.15	.....
" **Sulfate**	.10	.15	.20	.30	.....
" **Sulfate,** C. P.	.20	.40	.60	1.00	.....
Bauxite (Aluminum Hydroxide) mineral, selected	....	....	....	.35	.....
Beef Extract	....	....	....	....	2 oz. .75
Beeswax, yellow	.15	.30	.50	1.00	.....
Benzene, C. P.	....	....	....	1.00	.....
Beta Napthol	.30	.65	1.25	....	.....
Bismuth Metal	.35	1.00	2.00	3.75	.....
" **Chloride**	.60	2.00	....	....	.....
" **Chloride,** C. P.	....	....	....	6.00	.....
" **Hydroxide,** C. P.	....	....	....	6.15	.....
" **Nitrate**	.40	.95	1.60	3.00	.....
" **Nitrate,** C. P.	....	....	....	4.00	.....
" **Oxychloride**	.50	1.30	2.50	4.85	.....
" **Subnitrate**	.45	1.20	2.15	4.25	.....
" **Subnitrate,** C. P.	....	....	....	5.50	.....
" **Trichloride** (Bismuth Chloride)	.60	2.00	....	....	.....
Black Antimony (Antimony Trisulfide)	.15	.20	.30	.50	.....
" **Lead,** flakes (graphite)	....	.25	.40	.80	.....
" **Oxide of Manganese** (Manganese Dioxide)	.15	.20	.25	.35	.....
Bleaching Powder (Calcium Hypochlorite)	....	....	....	....	2 oz. .12
					5 o .18
					12 oz. .25
Blue Vitriol (Copper Sulfate)	....	.10	.15	.20	5 lb. .90
Bone Black (Charcoal, animal)	....	.15	.25	.40	5 lb. 1.75
Borax, crystallized (Sodium Bi- or Tetraborate)	....	.15	.25	.35	5 lb. 1.40
Bromine	.50	.75	1.00	2.00	.....
C					
Cadmium, metal	.30	.75	1.40	2.75	.....
" **Carbonate,** C. P.	....	....	....	4.50	.....
" **Chloride,** pure	.50	1.25	2.00	3.75	.....
" **Chloride,** C. P. crystallized	....	....	....	4.00	5 lb. 16.50

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Cadmium Nitrate	$0.35	$0.85	$1.50	$2.75	
" **Nitrate,** C. P.	.45	1.25	....	3.50	
" **Sulfate,** C. P.	....	....	....	3.75	
Calcite (Mineral) Cleavable	....	....	....	.25	
Calcium Carbide	....	....	....	....	2 lb. can $0.50
" **Carbonate** (marble chips)	....	.10	.12	.15	5 lb. .40
" **Carbonate** (Precipitated Chalk)	.10	.15	.20	.35	
" **Chloride,** lumps	....	.25	.35	.50	5 lb. 2.00
" **Chloride,** crystallized, C. P.	....	....	.55	.95	
" **Chloride,** anhydrous, for dessicators	.25	....	....	.75	2 lb. 1.50
					5 lb. 3.50
" **Chloride,** C. P., anhydrous, 8 mesh, for drying tubes	.25	.50	.75	1.25	5 lb. 5.00
" **Fluoride** (Fluorspar)	.10	.12	.15	.25	
" **Hypochlorite** (Bleaching Powder, Chloride of Lime)	....	....	....	....	2 oz. .12
					5 oz. .18
					12 oz. .25
" **Nitrate,** C. P.	.25	.45	.75	1.30	
" **Oxide** (Quick Lime)	....	....	....	.15	2 lb. .25
" **Oxide,** from marble, C. P.	....	....	....	.50	5 lb. 1.75
" **Phosphate,** tribasic, technical	....	....	.30	.50	
" **Sulfate,** native (Selenite)	....	.25	.40	.75	
" **Sulfate,** native (Plaster Paris)	....	....	....	.15	5 lb. .50
" **Sulfate,** C. P.	....	....	....	.85	
Calomel (Mercury (ous) Chloride)	.30	.60	1.00	2.00	
Camphor, refined, gum	.20	.60	1.00	1.75	
Cannel Coal	....	....	.10	.15	
Carbon Bi- or **Disulfide**	....	....	....	.50	
" **Bi-** or **Disulfide,** C. P.	....	....	....	1.00	5 lb. 3.50
" **Tetrachloride**	.15	.25	.35	.60	
" **Tetrachloride,** C. P.	....	....	....	1.00	5 lb. 4.00
Carborundum, lumps	....	....	.50	1.00	
" powder	....	....	.25	.50	
Carmine, No .40	1.25	4.00	....	....	
Casein from milk	.30	.50	....	....	
Castor Oil	....	....	....	....	pt. 1.00
Caustic Potash (Potassium Hydroxide) sticks	....	.40	.60	1.00	
" **Soda** (Sodium Hydroxide) sticks	....	.35	.50	.85	
Cerussite (Mineral) (Lead Carbonate)	....	.35	.60	1.00	
Chalk, precipitated (Calcium Carbonate)	.10	.15	.20	.35	
Charcoal, animal (Bone (ivory) Black)	....	.15	.25	.40	5 lb. 1.75
" wood, lumps	....	....	....	.12	5 lb. .50
" wood, powder	....	.15	.25	.40	5 lb. 1.75
" wood, blocks (Hardwood)	....	....	....	....	doz. 1.15
China Clay (Kaolin)	....	.10	.15	.25	5 lb. 1.00
Chloride of Lime (Calcium Hypochlorite)	....	....	....	....	2 oz. .12
					5 oz. .18
					12 oz. .25
Chloroform, C. P.	....	....	....	....	5 lb. 7.00
" U. S. P.	.25	.45	.75	1.25	
Chrome Yellow (Lead Chromate)	.30	.60	1.00	1.80	
Chromium Oxide, tri (Acid Chromic)	.30	.60	1.00	1.80	
" **Potassium Sulfate** (Chrome Alum) technical	.15	.25	.40	.75	
" **Sulfate,** dry pure	.25	.60	....	....	
Cinnabar (Mercury Sulfide, red)	.50	1.25	2.25	4.50	
Cobalt Acetate, C. P.	....	....	....	....	5 lb. 16.50
" **Chloride**	.50	1.10	....	....	
" **Nitrate,** pure	.40	1.35	....	....	
" **Nitrate,** C. P.	.50	1.40	....	....	

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Cochineal	$0.20	$0.60	$1.10	$2.00	.....
Congo Red	1.00	....	....	....	10 gr. $0.50
Copper Metal, very thin foil	.40	.75	1.25	2.50	.....
" **Metal,** gauze, 80 mesh, 4 x 4 inches	....	....	....	....	piece .30
" **Metal,** rivets, ½-inch	....	.30	.50	1.00	.....
" **Metal,** sheet	....	.25	.40	.75	.....
" **Metal,** shot	....	.25	.35	.70	.....
" **Metal,** turnings or shavings	....	.25	.40	.75	.....
" **Metal,** wire, No. 20 B. & S.	....	.35	....	1.00	.....
" **Metal,** wire, No. 24 B. & S.	....	.42	....	1.15	.....
" **Ammonium Chloride,** C. P.	....	....	....	1.00	5 lb. 4.75
" (ic) **Bromide** (di), pure	.50	1.50	....	....	.....
" (ic) **Bromide** (di). C. P.	.95	3.00	....	....	.....
" (ous) **Chloride,** white	.35	.90	....	....	.....
" (ic) **Chloride,** pure	.25	.45	.70	1.25	.....
" (ic) **Chloride,** C. P.	....	....	....	1.35	5 lb. 5.50
" **Nitrate**	.20	.45	.70	1.10	.....
" **Nitrate,** C. P.	....	....	....	1.25	5 lb. 5.25
" (ic) **Oxide,** black powder	.20	.45	.75	1.25	.....
" (ic) **Oxide,** black powder, C. P.	.25	.60	1.00	1.75	5 lb. 7.00
" (ic) **Oxide,** black wire	.35	.75	1.25	2.25	.....
" **Potassium Chloride,** C. P.	....	....	....	1.30	5 lb. 6.00
" (ic) **Sulfate,** crystallized (Blue Vitriol)	....	.10	.15	.20	5 lb. .90
" (ic) **Sulfate,** fine, crystallized, C. P.	....	.35	.60	1.00	5 lb. 3.75
" (ic) **Sulfate,** anhydrous, C. P.	.25	.60	.90	1.60	.....
Corrosive Sublimate (Mercuric Chloride) granulated	.30	.50	.85	1.60	.....
Cotton, Absorbent	....	.40	.75	1.25	.....
Cotton Seed Oil	....	....	....	....	pt. .50
Cream of Tartar (Potassium Bitartrate)	.20	.35	.60	1.00	.....
D					
Dextrine, yellow, technical	....	.15	.20	.35	.....
" white, from corn	....	.15	.20	.35	.....
Diamond Ink	.85	....	....	....	.....
Diastase of Malt, U. S. P.	1.00	3.00	....	....	.....
Dimethyl Glyoxime	5.00	....	....	....	.....
E					
Emery, powdered, flour	....	....	....	.25	.....
Eosine Solution	.50	....	....	....	.....
Epsom Salts (Magnesium Sulfate)	.15	.20	.30	.50	.....
Ether, Acetic, C. P. absolute	....	....	....	2.35	.....
" **Petroleum**	....	....	....	1.00	.....
" U. S. P.	....	.35	.50	.75	.....
" washed	....	....	....	1.50	.....
F					
Fehling's Solution, tablets	....	....	....	....	pkg. 1.00
Flaxseed	.10	....	....	....	.....
Fluorspar (Calcium Fluoride)	.10	.12	.15	.25	.....
Formaldehyde, 37%	....	....	....	.75	5 lb. 3.00
Fuchsine (Rosaniline)	....	....	....	....	10 gr. 1.00
G					
Galena (Lead Sulfide)	.10	.20	.30	.60	.....
Gelatine, white	....	1.00	2.00	4.00	.....
Glass Wool, fine threads	.45	....	....	....	¼ oz. .20
Glauber's Salt (Sodium Sulfate)	.15	.20	.30	.45	.....
Glucose (Dextrose) syrupy	....	.75	1.10	2.00	.....

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Glycerine, white, U. S. P.	$0.20	$0.35	$0.60	$1.00	
Gold Metal, leaf, pure	....	....	....	....	bk. $1.40
Grape Sugar, (Dextrose) lumps	....	.15	.25	.35	
Graphite, flakes (Black Lead, Plumbago)	....	.25	.40	.80	
Gum Arabic (Acacia)	.20	.35	.65	1.25	
" **Camphor**	.20	.60	1.00	1.75	
Gypsum (Calcium Sulfate)	....	.25	.40	.75	
H					
Hæmatoxylon (Logwood) ground	....	.25	....	....	
Hematite (Ferric Oxide)	....	.15	.25	.35	
Hide Powder, commercial	....	....	....	.85	
" for Standardizing	.75	....	....	6.50	
Hydrogen Fluoride (Acid, Hydrofluoric) 48% commercial	.50	.75	....	....	
" **Peroxide,** U. S. P.	....	.15	.20	.30	
" **Sulfide,** water or solution	....	....	....	1.00	
Hydrone for generating H	....	....	....	....	2 lb. 4.00
Hydroquinone (Hydrochinone)	.30	.85	....	....	
I					
Indigo	.30	.90	1.50	2.75	
Infusorial Earth	....	....	....	.35	
Ink, Diamond	.85	....	....	....	
Iodine, resublimed, U. S. P.	.75	2.00	3.75	7.00	
Iron Metal, filings, fine, cleaned	....	.10	.18	.25	5 lb. 1.00
" **Metal,** powdered, by hydrogen	.30	.60	1.00	2.00	
" **Metal,** wire, No. 16 B. & S.	....	....	....	.50	
" **Metal,** wire, No. 25 B. & S.	....	....	....	.60	
" **Metal,** wire, for standardizing, on spool	.35	.65	1.00	....	
" (ic) **Ammonium Citrate,** scales, green	.35	.60	1.00	2.00	
" (ic) **Ammonium Sulfate** (Ferric (Iron) Alum)	.20	.30	.40	.65	
" (ic) **Ammonium Sulfate,** C. P.	....	....	....	1.20	5 lb. 4.50
" (ous) **Carbonate** (Siderite)	....	.15	.25	.35	
" **Card Teeth**	....	.20	....	....	
" (ic) **Chloride** (Per-, Tri-, or Sesqui-chloride)	.20	.30	.40	.60	
" (ic) **Chloride,** C. P.	....	....	....	....	5 lb. 3.25
" (ous) **Chloride** (Protochloride) dry, pure	.25	.50	.85	1.40	
" (ic) **Nitrate,** crystallized, C. P.	.30	.60	.85	1.35	5 lb. 4.75
" (ic) **Oxide** (Hematite) red	....	.15	.25	.35	
" (ic) **Oxide** (Jeweler's Rouge) red	....	....	....	.75	
" **Pyrites**	.12	.15	.25	.35	
" (ic) **Sulfate,** C. P.	.20	.35	.60	.90	5 lb. 4.00
" (ous) **Sulfate,** crystals	....	.20	.25	.35	
" (ous) **Sulfate,** crystals, C. P.	.20	.35	.45	.75	5 lb. 2.75
" (ous) **Sulfide,** sticks, pure	....	.15	.20	.35	5 lb. 1.50
" **Watch Springs**	....	....	....	....	doz. .30
J					
Javelle Water	....	....	....	....	pt. .50
Jeweler's Rouge	....	....	....	.75	
K					
Kaolin (China Clay)	....	.10	.15	.25	5 lb. 1.00

L	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Lead Metal, foil (Tea Lead)	....	$0.15	$0.25	$0.35	.....
" **Metal,** granulated	$0.15	.20	.30	.50	.....
" **Metal,** sheet	....	.12	.18	.25	5 lb. $1.00
" **Metal,** shot	....	.10	.15	.25	5 lb. 1.00
" **Metal,** wire	....	.20	.30	.65	.....
" **Acetate,** crystallized	.18	.30	.40	.65	.....
" **Acetate,** crystallized, C. P.	....	....	....	1.00	5 lb. 3.50
" **Carbonate** (White Lead)	....	.18	.25	.40	.....
" **Chloride**	.30	.60	1.00	1.80	.....
" **Chloride,** C. P.	....	....	....	2.00	.....
" **Chromate** (Chrome yellow)	.30	.60	1.00	1.80	.....
" **Chromate,** fused, C. P.	....	....	....	2.00	.....
" **Nitrate,** technical	.18	.25	.40	.60	.....
" **Nitrate,** C. P.	.25	.40	.70	1.00	.....
" **Oxide, Mono-** or **Prot.,** yellow (Litharge)	....	.15	.20	.30	.....
" **Oxide, Di** (Per) Commercial	.20	.30	.40	.65	.....
" **Oxide, Di** (Per) C. P.	....	....	....	1.25	.....
" **Oxide, Tetra-** or **Sesqui-,** red (Minium)	.12	.15	.20	.30	5 lb. 1.25
" **Sulfide** (Galena)	.10	.20	.30	.60	.....
Lignite (Mineral)	....	....	....	.35	.....
Lime (Calcium Oxide, Quick Lime)	....	....	....	.15	2 lb. .25
" **Water**	....	....	.25	.40	.....
Limonite	....	.15	.20	.30	.....
Litharge (Lead Oxide, Mono- or Prot.)	....	.15	.20	.30	.....
Lithium Chloride, pure	.45	1.25	....	....	.....
" **Chloride,** C. P.	.50	....	....	4.50	.....
" **Nitrate**	.45	....	....	....	.....
" **Nitrate,** C. P.	....	....	....	5.00	.....
Litmus Cubes	.25	1.00	1.75	3.50	.....
" **Paper** — see **Test Paper**					
" **Pencils,** red or blue	....	....	....	....	each .35
Logwood, ground (Hæmatoxylon)	....	.25	....	....	.....

M

Magnesium Metal, powdered	.50	1.25	2.50	4.75	.....
" **Metal,** ribbon	1.50	....	....	....	.....
" **Ammonium Chloride,** C. P.	....	....	....	1.00	.....
" **Carbonate,** powdered	.15	.25	.35	.60	.....
" **Chloride,** crystallized, technical	.20	.35	.45	.75	.....
" **Chloride,** crystallized, C. P.	....	....	....	.80	5 lb. 3.25
" **Nitrate,** C. P.	....	....	....	1.10	5 lb. 4.50
" **Oxide,** (Magnesia)	.25	.45	.80	1.50	.....
" **Oxide,** C. P.	....	....	....	3.00	5 lb. 11.75
" **Sulfate,** crystallized (Epsom Salts)	.15	.20	.30	.50	.....
" **Sulfate,** crystallized, C. P.	....	....	....	.75	5 lb. 2.75
Malachite, green	1.50	....	....	....	10 gr. .75
Manganese Chloride, technical	.25	.45	.75	1.25	.....
" **Chloride,** C. P.	....	....	....	1.50	.....
" **Di-** or **Peroxide** (Black Oxide of Manganese) granulated	.15	.20	.25	.35	.....
" **Di-** or **Peroxide** (Black Oxide of Manganese) powdered, 95%	.15	.20	.25	.35	.....
" **Di-** or **Peroxide** (Black Oxide of Manganese) powdered, C. P.	.30	.50	.95	....	.....
" **Nitrate,** C. P. solution	....	....	....	2.75	.....

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Manganese Sulfate, technical	$0.25	$0.40	$0.65	$1.15	
" **Sulfate,** C. P.	....	....	....	1.25	
Marble Chips (Calcium Carbonate)	....	.10	.12	.15	5 lb. $0.40
Massicot (Lead Monoxide)	....	.15	.20	.30	
Mercury Metal, redistilled	....	....	....	1.50	
" (ic) **Bromide,** C. P.	.85	....	....	....	
" (ic) **Chloride** (Corrosive Sublimate) granulated	.30	.50	.85	1.60	
" (ic) **Chloride,** crystallized, C. P.	....	....	....	2.50	5 lb. 10.00
" (ous) **Chloride** (Calomel)	.30	.60	1.00	2.00	
" (ous) **Chloride,** C. P.	....	....	....	2.75	5 lb. 11.50
" (ic) **Nitrate**	.40	.75	1.50	3.00	
" (ic) **Nitrate,** C. P.	.50	....	....	3.50	5 lb. 15.00
" (ous) **Nitrate,** C. P.	....	....	2.50	....	
" (ous) **Nitrate,** pure	.40	1.25	2.00	4.00	
" (ic) **Oxide** (Red Precipitate)	.35	.65	1.00	2.00	
" (ic) **Sulfide,** red (Cinnabar)	.50	1.25	2.25	4.50	
Methyl Acetate	....	.75	....	....	
Methyl Orange	....	....	....	....	10 gr. .75
" **Red Solution**	....	....	....	....	25 gr. 5.00
" **Violet**	....	....	....	....	10 gr. .75
Methylene Blue	....	....	....	....	10 gr. .75
Microcosmic Salt (Sodium Ammonium Phosphate)	.25	.50	.85	1.50	
Minium (Lead Oxide, red)	.12	.15	.20	.30	5 lb. 1.25

N

Napthalene Flakes (Tar Camphor)	....	....	.20	.35	
Nessler's Solution	.50	1.00	1.75	....	
Nickel Metal, sheet	.35	.75	1.50	2.75	
" **Ammonium Sulfate,** C. P.	....	....	....	1.15	5 lb. 4.25
" **Ammonium Sulfate,** technical	.15	.25	.40	.65	
" **Chloride**	.25	.50	....	....	
" **Chloride,** C. P.	....	....	....	2.50	
" **Nitrate,** pure	.35	.75	....	....	
" **Nitrate,** C. P.	....	....	....	2.00	
" **Sulfate**	.15	.30	....	....	
Nigrosine	....	....	....	....	10 gr. .75
Nitre (Potassium Nitrate)	.15	.20	.30	.50	
Nutgall, powdered	.20	....	....	....	

O

Oil, Aniline (Aniline, pure)	.20	.45	.65	....	
" **Castor,** white	....	....	....	....	pt. 1.00
" **Cottonseed**	....	....	....	....	pt. .50
" **Olive** (Sweet)	....	....	....	....	pt. 1.50
" **Vitriol** — see **Acid,** Sulfuric.					
Ox-Gall, purified, U. S. P.	.50	1.50	....	....	

P

Pancreatin, pure, U. S. P. powdered	.65	1.75	....	....	
Papers, Test — see **Test Papers.**					
Paraffine, solid	....	.15	.20	.35	
Parchment Bond Paper, best quality	....	....	....	....	sheet .15 quire 3.00
Pepsin, powdered, U. S. P.	.75	2.00	....	....	

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz	Lb.	Misc.
Petrolatum (Vaseline)	....	....	....	$0.50	.....
Phenol (Acid, Carbolic)	$0.20	$0.30	$0.45	.75	.....
Phenolphthalein, dry	.50	....	....	....	.....
Phosphorous, Yellow, sticks	.40	.60	1.00	2.00	.....
" **Red,** Amorphous	.40	....	....	....	.....
Picture Wire	....	....	....	....	pkg. $0.10
Plaster of Paris (Calcium Sulfate)	....	....	....	.15	5 lb. .50
Platinum (ic) **Chloride** (Chloroplatinic Acid) solution, 5%	5.00	....	....	....	.....
Plumbago (Graphite) flakes	....	.25	.40	.80	.....
Potassium Metal	....	....	....	....	¼ oz. 1.50
" **Ammonium Sulfate,** C. P.	....	....	....	1.50	.....
" **Antimonyl Tartrate,** C. P.	....	....	....	2.00	.....
" **Antimonyl Tartrate** (Tartar Emetic)	.20	.35	.60	1.15	.....
" **Arsenite,** C. P.	....	....	....	2.50	.....
" **Bicarbonate,** C. P.	....	....	....	1.25	5 lb. 5.00
" **Bi- or Dichromate,** crystallized, technical	.15	.20	.25	.40	.....
" **Bi- or Dichromate,** crystallized, C. P.	.25	.50	....	1.25	5 lb. 5.00
" **Bi- or Disulfate** (Potassium Hydrogen Sulfate)	....	.50	....	1.25	.....
" **Bi- or Disulfate,** fused, C. P.	....	....	....	1.50	5 lb. 6.50
" **Bitartrate** (Cream of Tartar) pure, powdered	.20	.35	.60	1.00	.....
" **Bitartrate,** powdered, C. P.	....	....	....	2.25	.....
" **Bromide,** granulated, U. S. P.	.20	.30	.40	.75	.....
" **Bromide,** C. P.	....	....	....	1.25	5 lb. 5.00
" **Carbonate,** granulated, purified (Salt of Tartar)	.20	.30	.40	.75	.....
" **Carbonate,** C. P., anhydrous	....	....	....	1.25	.....
" **Carbonate,** crystallized, C. P.	....	....	.75	1.10	5 lb. 4.50
" **Chlorate,** crystallized, commercial	.15	.30	.45	.75	.....
" **Chlorate,** crystallized, C. P.	.25	.45	.65	1.00	.....
" **Chlorate,** powdered, U. S. P.	.15	.30	.50	.85	.....
" **Chloride,** technical	.15	.25	.35	.65	.....
" **Chloride,** C. P.	.25	.45	.75	1.25	5 lb. 5.00
" **Chromate,** pure	.25	.50	.80	1.50	.....
" **Chromate,** C. P.	....	....	....	2.25	.....
" **Chromium Sulfate** (Alum Chrome)	.15	.25	.40	.75	.....
" **Cyanide**	.50	.75	1.00	2.25	.....
" **Cyanide,** C. P.	....	1.00	1.75	3.00	.....
" **Ferricyanide** (Red Prussiate of Potash), crystallized, technical	.25	.45	.75	1.25	.....
" **Ferricyanide,** C. P.	.35	.85	....	2.50	.....
" **Ferrocyanide** (Yellow Prussiate of Potash) crystallized, technical	.20	.40	.65	1.10	.....
" **Ferrocyanide,** crystallized, C. P.	.30	.75	....	2.10	.....
" **Hydrogen Sulfate** (Potassium Bi- or Disulfate)	....	.50	....	1.25	.....
" **Hydroxide,** sticks, pure	....	.40	.60	1.00	.....
" **Hydroxide,** sticks, C. P.	....	.60	1.00	1.75	.....
" **Hydroxide,** sticks, C. P. by alcohol	....	.55	.85	1.50	5 lb. 6.00
" **Iodide,** crystallized, U. S. P.	.60	1.50	2.75	5.50	.....
" **Iodide,** crystallized, C. P.	.75	1.75	....	6.25	5 lb. 27.50
" **Nitrate** (Saltpeter) crystallized	.15	.20	.30	.50	.....
" **Nitrate,** crystallized, C. P.	.25	.50	.75	1.25	5 lb. 5.00
" **Nitrate,** C. P., fused sticks	....	....	....	1.75	.....
" **Nitrite,** sticks, C P.	....	....	1.65	....	.....
" **Nitrite,** sticks, pure	.40	.80	1.50	2.75	.....
" **Oxalate**	.25	.60	....	....	.....
" **Oxalate,** C. P.	....	....	....	2.25	.....
" **Perchlorate**	.40	.85	....	....	.....
" **Permanganate**	.20	.40	.60	1.00	.....
" **Permanganate,** C. P.	....	.75	....	2.00	.....
" **Phosphate, Primary,** C. P. (Monobasic)	....	....	....	2.25	5 lb. 9.00

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Potassium Sodium Tartrate, crystallized (Rochelle Salts)	$0.20	$0.35	$0.50	$1.00	.....
" **Sulfate**	.20	.30	.50	.85	.....
" **Sulfate,** crystallized, C. P.	.25	.50	.75	1.25	5 lb. $5.00
" **Sulfocyanide**	.50	1.10	2.00	3.50	.....
" **Tartrate,** pure	.30	....	....	....	.....
" **Tartrate,** crystallized, C. P.	....	....	....	2.25	.....
" **Thiocyanate,** C. P.	.50	1.25	2.10	3.75	.....
Primuline	1.50	....	....	....	.....
Pumice, powdered	....	.15	.20	.30	.....
" lumps	....	.15	.20	.30	.....
Q					
Quicklime (Calcium Oxide)	....	....	....	.15	2 lb. .25
Quicksilver (Mercury) redistilled	....	....	....	1.50	.....
R					
Red Lead (Lead Oxide, Minium)	.12	.15	.20	.30	5 lb. 1.25
" **Precipitate** (Mercury (ic) Oxide)	.35	.65	1.00	2.00	.....
Resorcin (Resorcinol)	.60	1.50	....	....	.....
Rochelle Salts (Potassium Sodium Tartrate)	.20	.35	.50	1.00	.....
Rosaniline (Fuchsine)	....	....	....	....	10 gr. 1.00
Rosin, yellow	....	....	....	.25	.....
Rouge, Jeweler's (Ferric Oxide)	....	....	....	.75	.....
S					
Saccharose, C. P., cane sugar	....	....	....	1.50	.....
Sal Ammoniac (Ammonium Chloride)	....	.12	.20	.35	5 lb. 1.60
" **Rochelle** (Sodium Potassium Tartrate)	.20	.35	.50	1.00	.....
" **Soda** (Sodium Carbonate)	....	.20	.25	.35	.....
" **Tartar** (Potassium Carbonate)	.20	.30	.40	.75	.....
Saltpeter (Potassium Nitrate)	.15	.20	.30	.50	.....
" **Chili** (Sodium Nitrate)	.15	.20	.25	.35	.....
Sealing Wax, sticks	....	....	....	1.20	.....
Shellac, Orange	....	.50	1.00	1.75	.....
Siderite (Ferrous Carbonate)	....	.15	.25	.35	.....
Silicon Dioxide	.10	.15	.20	.25	.....
Silver Bromide	1.75	6.25	....	....	.....
" **Chloride**	1.35	....	....	....	.....
" **Nitrate,** crystallized, U. S. P.	1.00	3.50	7.00	13.50	.....
" **Nitrate,** crystallized, C. P.	1.50	5.00	....	....	.....
" **Sulfate**	1.75	6.25	....	....	.....
Soap, Castile	.15	....	....	....	.....
Soda (Sodium Carbonate)	....	.20	.25	.35	.....
" **Baking** (Sodium Bicarbonate) powdered	....	.15	.18	.25	.....
" **Caustic** (Sodium Hydroxide)	....	.35	.50	.85	.....
" **Lime** (Sodium Calcium Hydrate)	....	.35	.60	1.00	.....
Sodium Metal	.50	.60	1.00	1.75	.....
" **Acetate,** crystallized	.20	.25	.35	.60	.....
" **Acetate,** C. P.	.25	....	....	.95	5 lb. 3.50
" **Amalgam**	.60	1.50	2.75	5.00	.....
" **Ammonium Phosphate,** C. P.	....	....	....	1.75	5 lb. 7.50
" **Ammonium Phosphate** (Microcosmic Salt)	.25	.50	.85	1.50	.....
" **Arsenate**	.25	.50	.75	1.25	.....
" **Arsenate,** C. P.	....	....	....	1.40	.....
" **Arsenite**	.25	.50	.75	1.25	.....
" **Bi- or Tetraborate** (Borax)	....	.15	.25	.35	5 lb. 1.40
" **Bicarbonate** (Baking Soda)	....	.15	.18	.25	.....
" **Bicarbonate** (Baking Soda) C. P.	....	....	....	.70	5 lb. 2.75
" **Bi- or Dichromate**	.20	.25	.35	.60	.....

	Prices Include Containers				
	Oz.	4 Oz.	8 Oz.	Lb.	Misc.
Sodium Bi- or Dichromate, crystallized, C. P.	$0.25	....	....	$1.00	5 lb. $4.00
" **Bismuthate**, C. P.	1.00	....	....	8.00	.....
" **Bisulfate**	.20	$0.30	$0.50	.75	.....
" **Bisulfate**, crystallized, C. P.	....	....	....	.85	5 lb. 3.75
" **Bisulfite**, purified	....	.30	....	.60	.....
" **Bitartrate**, crystallized, C. P.	....	....	....	2.00	5 lb. 9.00
" **Bromide**, C. P.	....	....	....	1.25	5 lb. 5.00
" **Calcium Hydrate** (Soda Lime) dry, 4 mesh	....	....	....	1.10	5 lb. 3.00
" **Calcium Hydrate** (Soda Lime)	....	.35	.60	1.00	.....
" **Carbonate** (Sal Soda)	....	.20	.25	.35	.....
" **Carbonate**, anhydrous, pure	....	....	.25	....	.....
" **Carbonate**, anhydrous, C. P.	....	....	....	.85	5 lb. 3.75
" **Carbonate**, crystallized, C. P.	....	....	....	.75	.....
" **Chloride** (Common Salt), fine, white	....	....	....	....	5 lb. .15
" **Chloride**, crystallized, C. P.	....	....	....	1.25	5 lb. 5.00
" **Hydroxide**, sticks	....	.35	.50	.85	.....
" **Hydroxide**, sticks, C. P. by alcohol	.25	.40	.60	1.00	5 lb. 4.00
" **Hydroxide**, sticks, C. P.	....	.50	.75	1.25	.....
" **Hyposulfite** (Thiosulfate)	....	.20	.25	.35	.....
" **Hyposulfite** (Thiosulfate) crystallized, C. P.	.25	....	....	.75	5 lb. 2.75
" **Nitrate** (Chili Saltpeter) crystallized, technical	.15	.20	.25	.35	.....
" **Nitrate**, crystallized, C. P.	.20	.40	.60	1.00	5 lb. 3.75
" **Nitrite**, sticks	.30	.50	.85	1.50	.....
" **Oxalate**	.35	.60	1.00	1.75	.....
" **Per- or Dioxide**, powdered, C. P.	.35	.60	1.00	1.75	.....
" **Per- or Dioxide**, fused (Oxone)	....	....	....	....	2 lb. 2.50
" **Phosphate** (Dibasic), granulated	.15	.20	.25	.35	.....
" **Phosphate** (Dibasic), crystallized, C. P.	.20	.40	.60	1.00	5 lb. 3.75
" **Phosphate**, primary (Monobasic)	....	....	....	1.25	.....
" **Potassium Carbonate**, C. P.	....	....	....	1.50	5 lb. 6.25
" **Potassium Tartrate** (Rochelle Salts)	.20	.35	.50	1.00	.....
" **Silicate**, solution, pure	....	.25	.30	.50	5 lb. 1.50
" **Sulfate** (Glauber's Salts)	.15	.20	.30	.45	.....
" **Sulfate**, anhydrous, powdered, C. P.	....	....	....	1.25	5 lb. 5.00
" **Sulfide**, crystallized	.20	.40	.60	1.00	.....
" **Sulfite**, crystallized	.15	.20	.25	.35	.....
" **Sulfite**, crystallized, C. P.	....	....	....	.75	.....
" **Tetraborate** (Borax)	....	.15	.25	.35	5 lb. 1.40
" **Thiosulfate** (Sodium Hyposulfite)	....	.20	.25	.35	.....
" **Thiosulfate** (Sodium Hyposulfite), C. P.	.25	....	....	.75	5 lb. 2.75
Starch, Corn	....	....	....	.20	.....
" **Potato**	....	....	....	.60	.....
Steel Wool	....	....	.60	1.00	.....
Strontium Chloride	.20	.25	.40	.75	.....
" **Nitrate**	.20	.25	.40	.75	.....
" **Nitrate**, C. P.	.30	....	....	1.50	.....
" **Oxalate**, C. P.	....	....	....	2.00	.....
" **Sulfate**, C. P.	....	....	....	1.50	.....
Sulphur Flowers (Sublimed)	....	....	.12	.15	.....
" **Roll** (Brimstone)	....	.10	.12	.15	.....
Sweet Oil (Olive Oil)	....	....	....	....	pt. 1.50

T

Tannin (Acid Tannic), powdered	.30	.75	1.25	2.25	.....
" (Acid Tannic), C. P.	.40	1.25	....	....	.....
Tartar Emetic (Antimony and Potassium Tartrate)	.20	.35	.60	1.15	.....
" **Emetic** (Antimony and Potassium Tartrate), C. P.	....	....	....	2.00	.....
Tea Lead (Lead Foil)	....	.15	.25	.35	.....

TEST PAPERS

	Oz.	Prices Include Containers 4 Oz.	8 Oz.	Lb.	Misc.
Litmus Paper, blue, sheets	....	....	....	....	Each $0.10
					Quire .75
in books of 50 strips	....	....	....	....	Book .10
" **Paper,** red, sheets	....	....	....	....	Each .10
					Quire .75
in books of 50 strips	....	....	....	....	Book .10
Pole Test Paper, sheets	....	....	....	....	Each .10
					Quire .75
Potassium Iodide Paper, sheets	....	....	....	....	Each .15
					Quire 1.25
Turmeric Paper, sheets	....	....	....	....	Each .10
					Quire .75
in books of 50 strips	....	....	....	....	Book .10
Tin Metal, foil (Composition)	....	$0.25	$0.40	$0.75	5 lb. 3.00
" **Metal,** granulated, mossy, pure	$0.30	.60	1.00	1.75	.....
" (ous) **Chloride** (Bi- or Stannous Chloride)	.20	.40	.60	1.00	.....
" (ous) **Chloride,** C. P.	....	....	....	1.75	5 lb. 7.50
" (ous) **Oxalate,** C. P.	....	....	....	2.75	.....
" (ic) **Oxide,** pure (Stannic Oxide)	.25	.50	....	....	.....
" (ous) **Sulfate,** C. P.	....	....	....	1.75	.....
Tripoli	....	....	....	.25	.....
Turmeric, powdered	.15	.20	.35	....	.....
" **Paper** — see **Test Papers.**					
Type Metal	....	....	.25	.50	.....
V					
Vaseline (Petrolatum)	....	....	....	.50	.....
W					
Water, distilled, in glass bottle	....	....	....	....	½ gal. 1.50
" **Glass** (Solution Sodium Silicate)	....	.25	.30	.50	5 lb. 1.50
White Lead (Lead Carbonate)	....	.18	.25	.40	.....
Whiting	....	.10	.15	.25	.....
X					
Xylene (Xylol or Dimethylbenzene)	.20	.30	.40	.70	.....
Z					
Zinc Metal, dust	....	.25	.40	.65	.....
" **Metal,** granulated, mossy, technical	....	.20	.25	.35	.....
" **Metal,** granulated, mossy, C. P.	.25	.35	.50	.80	5 lb. 3.25
" **Metal,** powdered, C. P.	....	....	....	....	5 lb. 3.25
" **Metal,** sheet	....	.20	.25	.35	.....
" **Metal,** sticks, C. P.	....	....	....	1.25	.....
" C. P., arsenic free, stick form	....	....	....	1.25	.....
" **Metal,** wire	....	....	....	....	Ft. .10
" **Acetate**	....	.30	.50	.90	.....
" **Acetate,** C. P.	....	....	....	1.25	.....
" **Carbonate,** C. P.	....	....	....	2.00	.....
" **Chloride**	.20	.35	.45	.75	.....
" **Chloride,** granulated, C. P.	....	....	....	1.00	5 lb. 4.00
" **Nitrate**	.25	.45	.75	1.25	.....
" **Nitrate,** crystallized, C. P.	....	....	.80	1.45	5 lb. 4.50
" **Oxide**	....	.20	.30	.50	.....
" **Oxide,** dry process, C. P.	....	....	....	1.00	5 lb. 3.75
" **Oxide,** wet process, C. P.	.25	....	....	....	.....
" **Sulfate,** crystals	.15	.20	.25	.35	.....
" **Sulfate,** crystals, C. P.	....	....	....	1.00	5 lb. 3.75

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